APPLIED

Hydraulics & Pneumatics

STEMS • COMPONENTS • SERVOS • ELECTRIC CONTROLS **NOVEMBER 1958**

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DRILLED MANIFOLDS

see contents page 2

THE MAGAZINE OF FLUID POWER
AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

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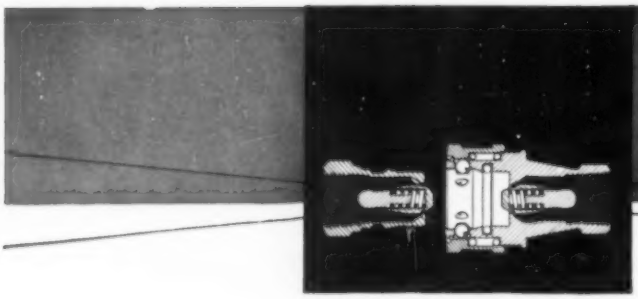

shuts off both sides of line... prevents loss of liquid, gas, or pressure.

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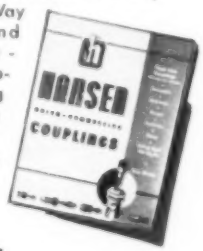

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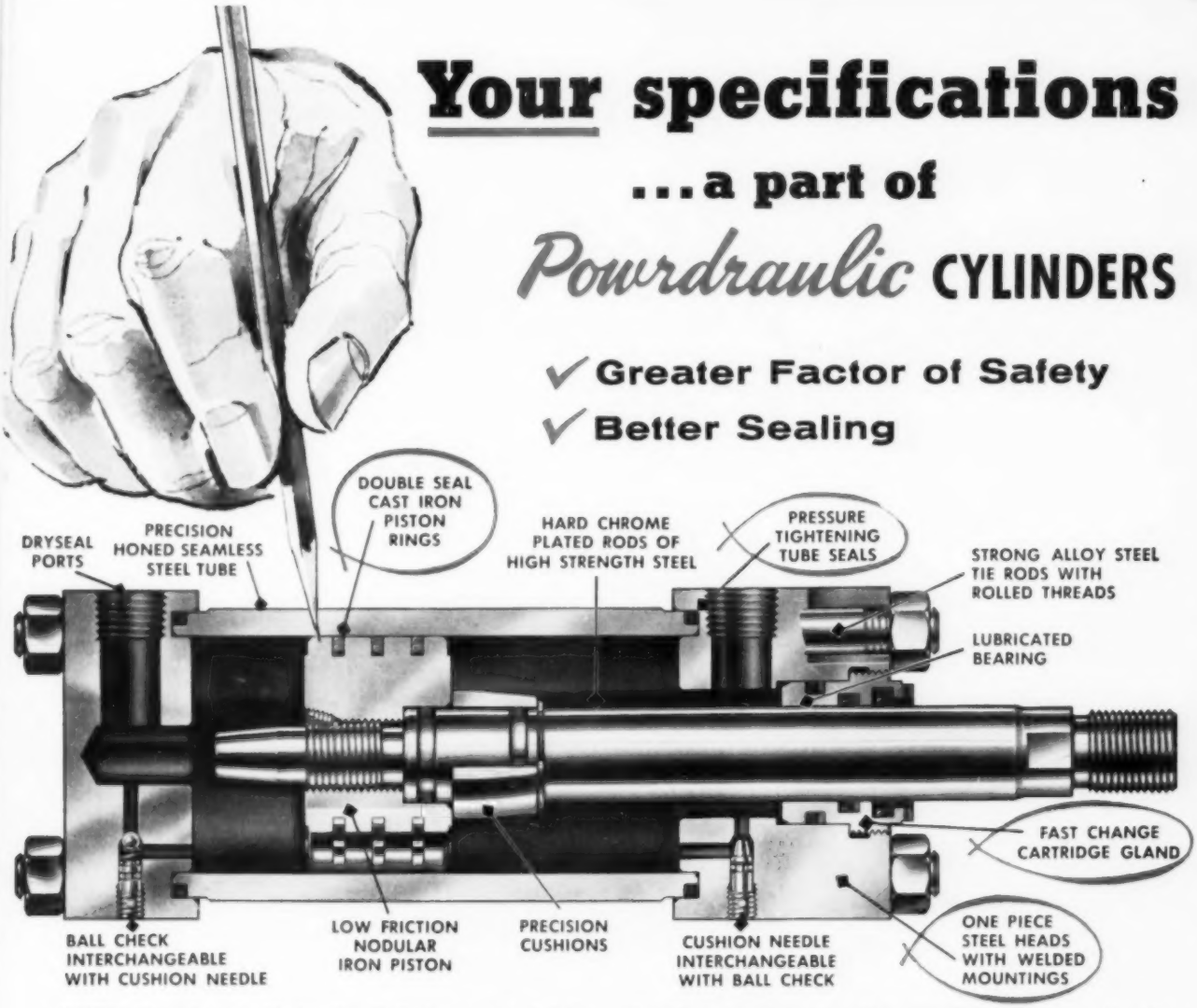
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PRECISION HONED SEAMLESS STEEL TUBE
DOUBLE SEAL CAST IRON PISTON RINGS
HARD CHROME PLATED RODS OF HIGH STRENGTH STEEL
PRESSURE TIGHTENING TUBE SEALS
STRONG ALLOY STEEL TIE RODS WITH ROLLED THREADS
LUBRICATED BEARING
FAST CHANGE CARTRIDGE GLAND
ONE PIECE STEEL HEADS WITH WELDED MOUNTINGS
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EXCLUSIVE PRESSURE TIGHTENING TUBE SEALS, located on the outside diameter of the cylinder tube, form a positive seal at all pressures from zero to maximum. Minute expansion of the tube due to pressure, squeezes the "O" ring making the seal even tighter. The "O" ring is fully confined between the head and the tube and will not extrude at high pressures. Unlike other cylinders that seal at the tube ends or inside diameter, the Hanna Powrdraulic Cylinder with pressure tightening O.D. seals will remain tight at all pressures.

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CIRCLE 63 ON TIME-SAVER CARD

APPLIED
Hydraulics & Pneumatics

VOLUME 11/NUMBER 11

NOVEMBER 1958

THE MAGAZINE OF FLUID POWER

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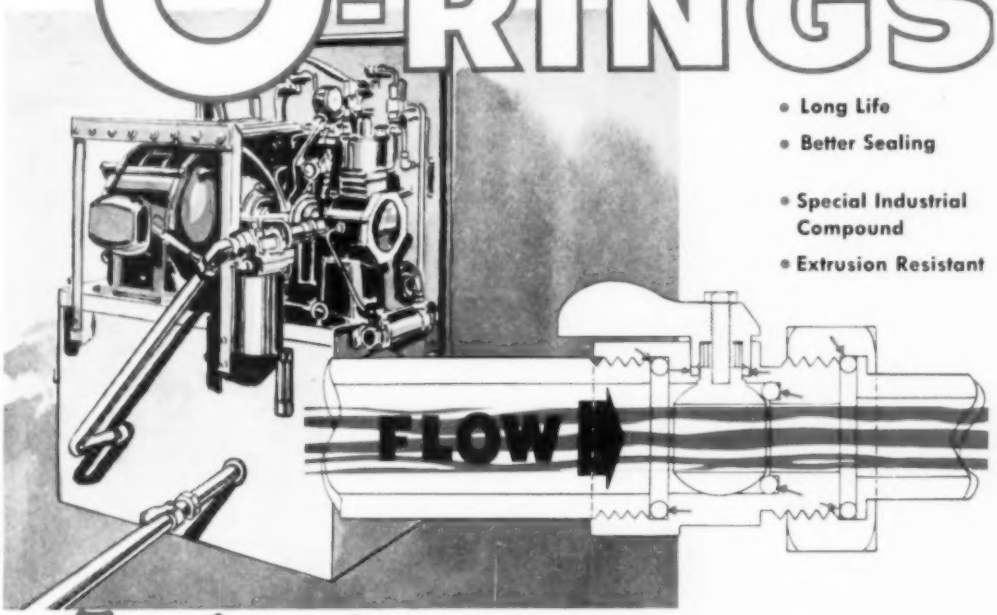
FACTS for FILING on O-RINGS



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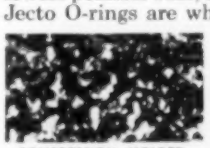

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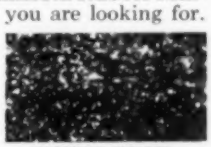

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APPLIED Hydraulics & Pneumatics

THE MAGAZINE OF FLUID POWER

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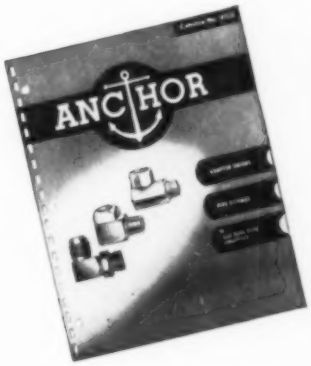
Expanded Line of Hydraulic Fittings, Unions and Adapters in New Anchor Catalog!



The new edition of Anchor's Catalog covering the complete and enlarged line of unions, fittings and adapters is just off the press and now available on request.

The Catalog contains a great deal of engineering data that will prove helpful to the engineer in planning his hydraulic connections.

The Anchor Line of Adapter Unions, Tees and Crosses is now even more complete in range of sizes and styles of fittings. Designed for use with Pressed On and Reusable Coupling Hose Assemblies, they provide a ground joint, leakproof connection, and eliminate one or more pipe thread joints. Assembly, especially in confined quarters, is made easier and twisting and straining of the hose during assembly is prevented.

The Anchor Line of SAE Straight Thread "O" Ring Boss Fittings and Adapters is described in detail with complete specifications. These fittings, with straight thread and "O" Ring Seal, ensure positive leakproof seating without danger of thread distortion or damage. Connections can be loosened and retightened any number of times without leaks. Straight, 45° and 90° Adjustable Elbows are available, as well as a tee, service tee and 90° check valve, in a wide range of sizes.

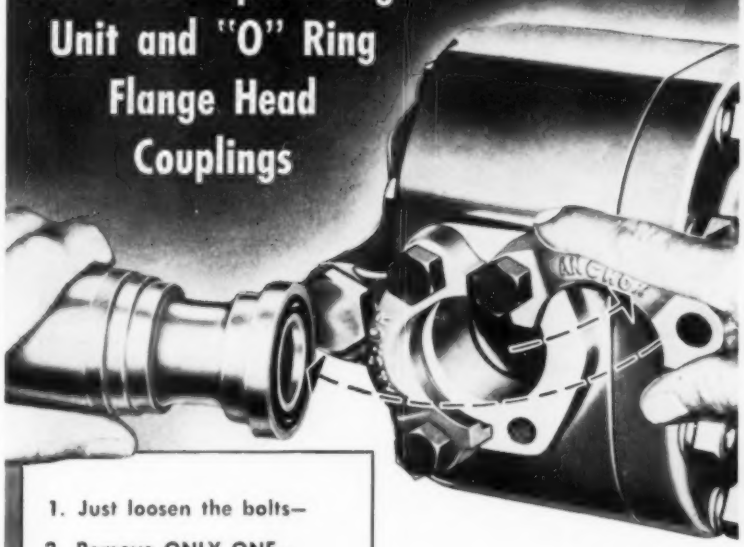
Several styles of Anchor Tube Nuts for tube diameters from 1/8" to 2" are shown.

Copies of the new Catalog No. 204 may be obtained by writing to Anchor Coupling Co. Inc., 308 North Fourth Street, Libertyville, Illinois.

Easier to Connect or Disconnect!

ANCHOR FLANCO®

SAE 4-Bolt Split-Flange Unit and "O" Ring Flange Head Couplings



1. Just loosen the bolts—
2. Remove ONLY ONE—
3. Pivot the Split-Flange Clamp Half, together with the "O" Ring Flange Head Coupling, around the other bolt—
4. Remove Hose Coupling!

To reconnect, just reverse the procedure.

Try connecting and reconnecting a FLANCO Coupling in close quarters to fully appreciate the convenience of this patented Split-Flange Clamp design!

In addition, with FLANCO couplings you can reduce production costs by eliminating costly pipe threading operations—use more easily handled, small, automotive type wrenches to make up joints—and you eliminate separate union and swivel connections. Hose lines can be disconnected and reconnected many times without leaks, because there are no threads to wear out or tapered seats to groove with FLANCO Split-Flange Halves and "O" Ring Flange Head Couplings.

FLANCO "O" Ring Flange Head Type Couplings are available in Pressed-On, or Reusable Clamp Type, as well as Weld Type Fittings.

Andy Anchor says:

You can get the complete story on FLANCO Split-Flange Halves and "O" Ring Flange Head Type Couplings by writing for Catalog 402.

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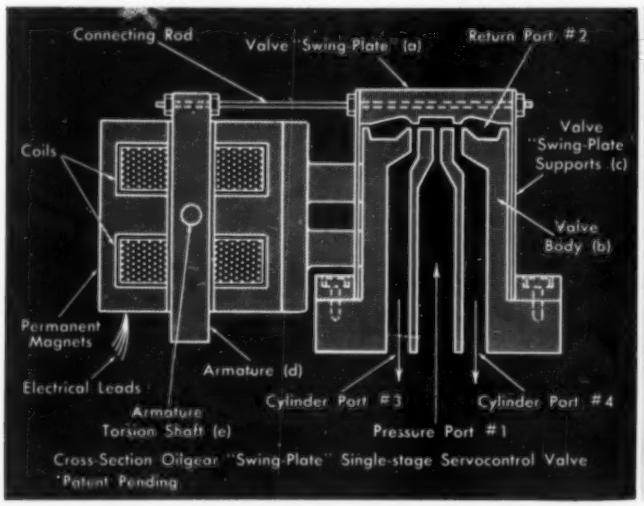
CIRCLE 126 ON TIME-SAVER CARD

. . . Fluid Power news

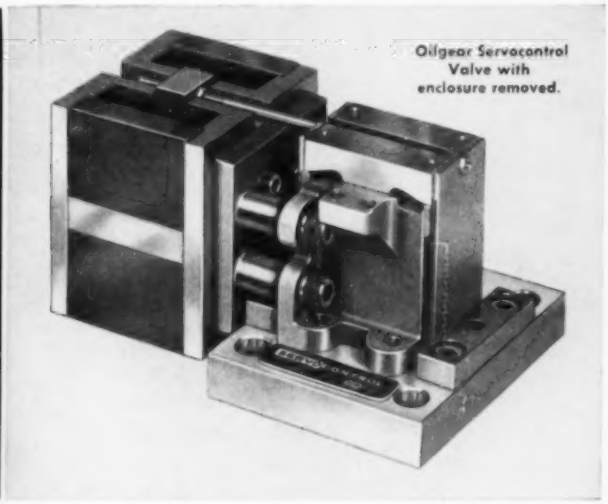
NEW INDUSTRIAL SERVO-CONTROL VALVES

New Oilgear Electrohydraulic Servocontrol Valves

SERVO VALVE DESIGN OBJECTIVES: 1: Greater control accuracy and resolution for rotation and straight-line drives. 2. For industrial applications, must be capable of controlling wide pressure and volume range with single-stage, fast response to a low input signal. 3. Eliminate conventional valve frictional problems between spools and cylinders. 4. Eliminate two-stage linkage and stability problems. 5. Eliminate first-stage pilot systems — supply pressure, centering devices, filters, and orifices required for pilot systems. 6. Provide a flow rate substantially linear to valve displacement, with stability in null position. 7. Eliminate or substantially reduce valve "dead-band," sticking, jamming, scoring. 8. Be "fail-safe." 9. Operate safely in hazardous locations.



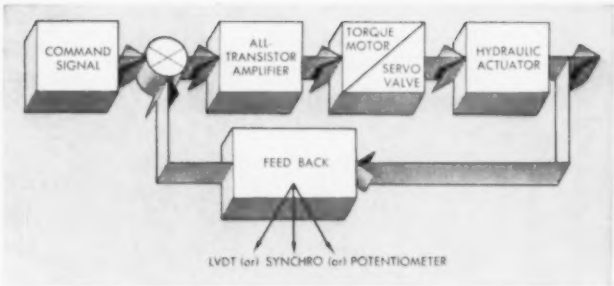
Cross-Section Oilgear "Swing-Plate" Single-stage Servocontrol Valve
*Patent Pending


Oilgear Servocontrol Valve with enclosure removed.

SOLUTION: 1. A new concept of three and four-way single-stage electrohydraulic servo valve construction . . . only two moving parts in Oilgear's new "Swing-Plate" design. 2. No metal-to-metal contact between "Swing-Plate" (a) and valve body (b) . . . frictionless for high sensitivity, fast response to minute signals — virtually eliminates sticking, scoring, jamming. 3. Clearances and port seal sizes can be varied to suit application and fluid handled. 4. Sharp, long rectangular chambers and lands linearize valve characteristics — flow rate essentially a linear function of valve displacement . . . supply high fluid power gain with minute "Swing-Plate" movement. 5. Hardened stainless steel construction assures reliable operation well in excess of a hundred million cycles, even with non-lubricating fluids. 6. No pilot system pressure, centering devices, orifices, or internal filters required. 7. Spring-steel supports (c) respond instantly to low torque motor forces. 8. As torque motor armature (d) pivots on torsion shaft (e), valve automatically centers in event of power failure for "fail-safe" operation. 9. For operation above 500 psi, a compensating cap equalizes hydraulic forces to maintain selected clearances. 10. No special modification required for use in hazardous locations. 11. Valves — open or enclosed — can be gasket-mounted. Pipe tap subplates are available.

PERFORMANCE DATA: Flow Rate—4 gpm at 250 psi; 8 gpm at 1000 psi pressure drop across valve. Supply Pressures—to 3000 psi. Torque Motor: Mid Position Force—11 lb min.; 5 watts max. power demand; Stroke—±0.015 inches; Hysteresis—less than 3%; Differential Current—150 ma; Resistance per Coil—80 ohms. Other coil current and resistance values available. Net Weight—4¼ lb. Width: 4¾"; Height: 2¾"; Depth: 3".

Oilgear can supply all components for Fluid Power Servocontrol systems . . . all-transistor amplifiers, manual controls, preset controls, two-stage servo valves, variable displacement pumps, variable speed drives, motors and cylinders.



New Oilgear Servocontrol components applied to controls on Oilgear pumps and transmissions provide greater system accuracy and resolution. Functions easily attained with new Oilgear Servocontrol open and closed-loop systems are: 1. Precision, high-response speed control from zero to maximum rpm in either direction through remote control stations or switches. 2. Positive, high response, follow-up position control through remote command units. 3. Output motions or speeds with closed-loop systems will remain near constant with accuracies from 0.1% to 1.5%, and with resolution down to 0.05%.

For further information on these new valves and systems, call your Oilgear Application-Engineer. Or write, stating your specific requirements, directly to . . .

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FLUID POWER LINES

about hydraulics & pneumatics

ELIMINATE LEAKAGE . . . One of the best ways to stop leakage is to eliminate connections by using manifolds. Two articles in this issue discuss their design and application. Lots of attention has been focused on these piping devices, because in addition to leakage control, they simplify piping and make a neater appearance than individual lines.

Several different manufacturing methods are being used to incorporate fluid lines in a block which mounts the system control valves. These include brazed sandwich construction, cast aluminum (for pneumatic circuits), and drilled blocks of either steel or aluminum. Although most drilled manifolds are from steel blocks, aluminum has several advantages, such as good machinability, light weight, and corrosion resistance. Some of the big machine tool builders using them have found that aluminum pipe plugs should be used instead of steel. They're working at 2000 to 3000 psi.

ELECTRICAL CONTROLS . . . The more you know about them the better you'll be at designing flexible, low cost fluid power systems. Many manufacturers of hydraulic and pneumatic machines now have one man who is responsible for designing both fluid power and electrical systems, because they must be carefully integrated and designed together. An example of this is given in *Timers Give Air Circuit A Memory.*

BOOSTER APPLICATION . . . When 1000 psi would do all the jobs on a machine except one, the designers reasoned that a booster would be the answer. To keep a machine for working wheel rims compact, a booster and cylinder unit was designed. It's described on page 86.

TRAPPED OIL . . . Oil trapped between piston packings can cause a lot of trouble by distorting packings and causing internal leakage around the piston. To learn what happens when oil is trapped, and for designs to correct the condition see page 101.

AIRCRAFT PNEUMATICS . . . Is air the ideal fluid for high pressure systems of future aircraft? Some designers think so, because of weight savings over hydraulic systems, and because it is not affected by nuclear radiation. The comparisons given in *High Pressure Pneumatics* are the results of studies at Convair.

DESIGNERS' GUIDE ISSUE . . . AH & P editors are now compiling the January 1959 Guide Issue. There will be more than 90 pages of charts to give you quick convenient answers about pressure and flow ratings, sizes, mountings and service for 32 hydraulic and pneumatic components made by over 600 companies. Also in this issue will be a products review of fluid power components introduced during 1958. You'll be using the Guide Issue throughout 1959.

valves, variable displacement pumps, variable speed drives, motors and cylinders.

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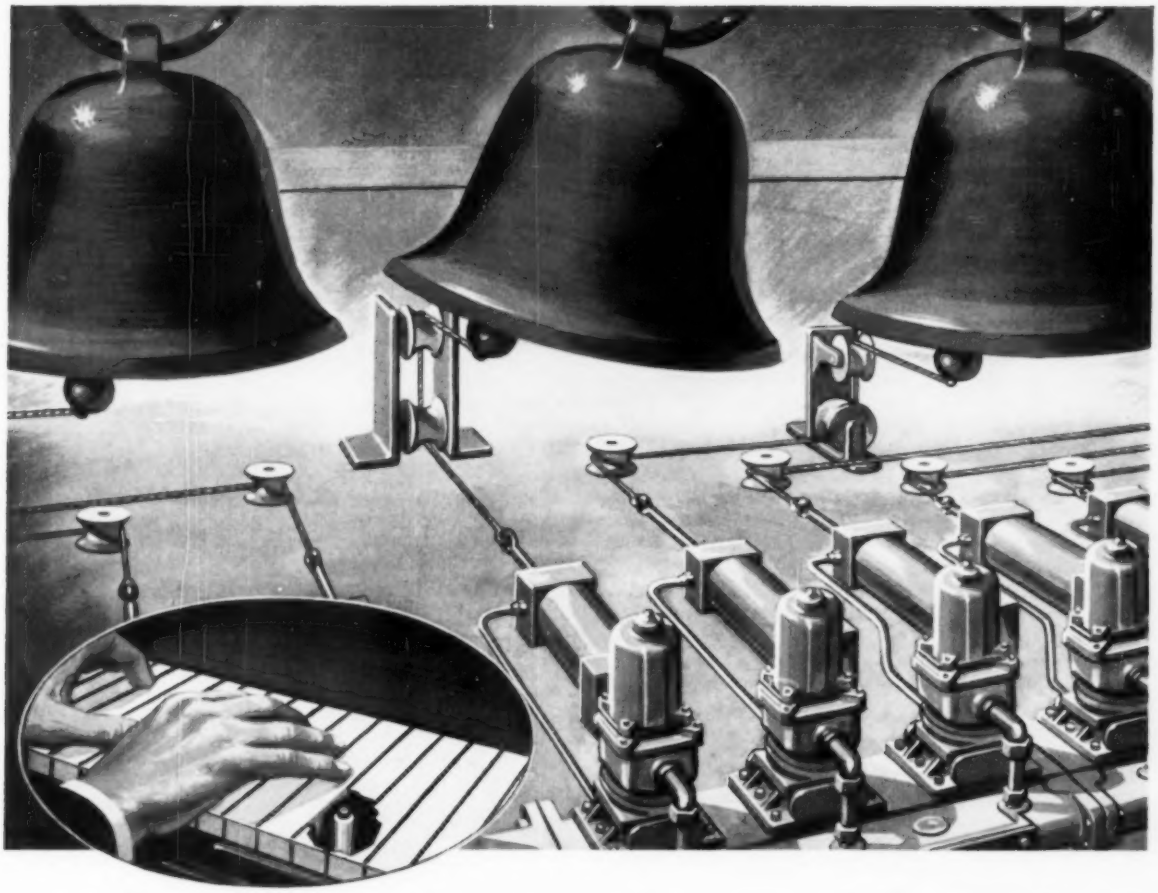


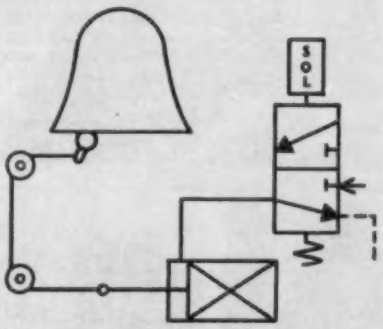
What? Air Power Rings the Bells!

Air powered clappers for the bell tower may be strictly fiction, but . . .

Can you imagine a keyboard that's a set of electrical switches. They operate a set of solenoid valves which in turn advance and retract cylinders. The cylinders, of course, pull the clapper cords. Shows that anything can happen when an air-minded engineer gets in the spirit of the season. But while this is just a flight of the imagination that you aren't likely to see installed in a carillon soon, you might very well want to take advantage of the underlying idea in some of your *plant operations*. Here is the idea:

Just one operator can control hundreds of operations by using solenoid valves.

And these solenoid valves, you'll notice, are manifolded. The manifolding saves piping, space, etc., just as has been possible for years with Ross valves that are operated manually, by air, cams, etc. Incidentally, you won't find this manifold in our catalog . . . it is one of the many refinements and variations of the standard Ross line that make it so flexible. To keep fully aware of the developments continually being made to increase the flexibility of the Ross line, keep in close touch with your local Ross Valve Engineer.



SEQUENCE OF OPERATION

Every time solenoid is energized, bell clapper is pulled against bell.

ROSS OPERATING VALVE CO. 105 East Golden Gate • Detroit 3, Michigan

CIRCLE 114 ON TIME-SAVER CARD

ACCO
Helicoid Gage
U.S.A.

NOTHING BUT THE BEST IN GAGES FOR WORKING PRESSURES FROM 30" VACUUM TO 10,000 p. s. i.

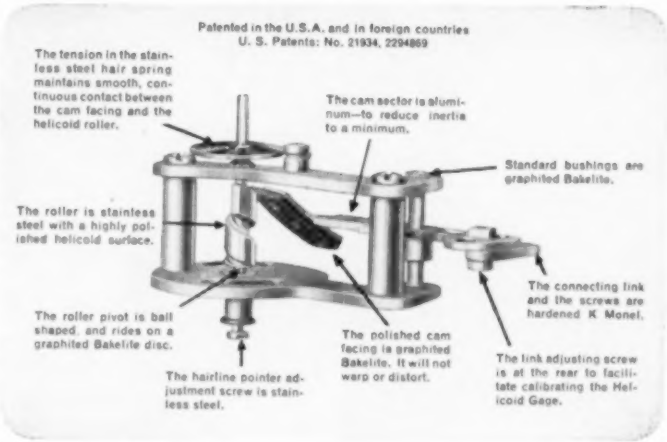
Shock-Proof Cam Actuation (no gears—no teeth) Makes Helicoid Gages Ideal for Hydraulic Services

Designed for pulsating and impact hydraulic service, the Helicoid movement releases at zero in the event of sudden pressure reduction. This eliminates shock on pointer and movement by reducing impact of pointer against pointer stop pin. This protects the gage mechanism where gages may be subject to occasional vacuum.

The superiority of Helicoid Gages is most evident in severe service—wherever a gage is subjected to violent pressure pulsations or certain severe mechanical vibrations.

The *sustained accuracy* of Helicoid Gages over *millions of cycles* is explained by the details of design and construction of the Helicoid movement shown at the right.

Rolling action of the cam facing against the roller surface . . . graphited Bakelite bushings, roller pivot base and cam facing . . . K Monel connecting links and screws . . . all such Helicoid features protect against wear and corrosion and assure sensitivity, sustained accuracy and trouble-free operation through millions of cycles.


Patented in the U.S.A. and in foreign countries
U. S. Patents: No. 21934, 2294869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is aluminum—to reduce inertia to a minimum.
Standard bushings are graphited Bakelite.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

HELICOID GAGE CARTRIDGE SNUBBER

(Patent pending)

This is a simple, effective throttling device to reduce or eliminate pulsations of the gage pointer. There are no moving parts, no adjustments needed. Available in three types in powdered bronze or stainless steel for air, gas, water, steam, medium or heavy liquids.

Enlarged cutaway view

Threaded cartridge body for assembly in any Helicoid Gage tapped socket shank

EASIEST ADJUSTMENT AND CALIBRATION

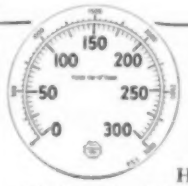
Only Helicoid Gages have the external pointer adjustment pictured here. The Helicoid type adjustment cannot be jarred out of position.

Calibration of Helicoid Gages is accomplished easily, without removing dial or pointer, because the link adjusting screw is at the rear of the system.

TUBES BUILT FOR MILLIONS OF PRESSURE PULSATIONS

To fit the wide range of applications, Helicoid Bourdon tubes are available in four materials—alloy steel, K Monel, stainless steel and phosphor bronze.

All Helicoid tubes are made from seamless tubing and are carefully designed to give maximum torque and minimum stress. When used within the dial range, they will withstand many millions of pressure pulsations and will not stretch, leak nor crack.



DOUBLE SCALE DIAL SHOWS TONS ON RAM AND PSI

Helicoid Gage dials are supplied in jet black with white figure markings or in dull white with black figure markings. They are constructed of laminated phenol with a transparent plastic surface and the longest possible scale length for more accurate readings. They are non-corroding, will not discolor nor fade and will not crack, chip nor peel.

Helicoid Gage Division
AMERICAN CHAIN & CABLE

929-H Connecticut Avenue • Bridgeport 2, Connecticut

ACCO
A·C·C
TRADE MARK

Helicoid gives you all these features at prices that are competitive in the quality gage field

CIRCLE 67 ON TIME-SAVER CARD

Rubber Parts engineered to your product by PRECISION

THE production of rubber seals, poppets and diaphragms of intricate shape and form – especially engineered to meet individual product requirements – is a Precision specialty. Parts are compression molded for uniform density ... have maximum resistance to compression set ... meet military-standards and specifications ... solve close tolerance problems.

If you're looking for the answer to a heat, compression, friction, or fluid resistance sealing problem, ask for the services of a recognized sealing specialist – the Precision engineer.

Precision "O" Rings, Rubber and Rubber Bonded-to-Metal Parts

Precision Rubber Products Corporation

"O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio Canadian plant at: Ste. Thèrése de Blainville, Québec

CIRCLE 106 ON TIME-SAVER CARD

Eastman

HIGH PRESSURE ASSEMBLIES

for

Responsive POWER

INSTANT response means extra POWER. Improving the "Power-Performance Ratio" of your equipment may mean an extra bucket per minute, extra tons per hour, extra loads per day.

With the increasing emphasis on POWER, it pays to safeguard the most important link in your hydraulic system with Eastman *High Pressure* Hose and Tube Assemblies.

Eastman Coupling Design gives you maximum orifice, consistent with essential safety and strength, to provide "trigger-response" through unrestricted flow from pump to point of work—plus prompt return.

BENT TUBING TO YOUR SPECIFICATIONS

Eastman's modern, hydraulically-controlled tube bending equipment provides bent tubing to your precise specifications—made with flared or beaded ends for your required fittings. Quality workmanship assures satisfactory performance. Mass production economies assure competitive quotations.

For positive power delivery and efficiency throughout your hydraulic system—plus appearance and sales appeal—it pays to specify Eastman High Pressure Hose and Tube Assemblies for your original equipment.

PERMANENTLY ATTACHED MALE (NPTF)

America's most popular OEM Coupling for 1, 2, and 3 wire braid rubber cover hose, and 4 spiral wire extra high pressure hose.
Sizes: ¼" thru 3".
Working Pressure: 375-5000 p.s.i.

PERMANENTLY ATTACHED SWIVEL FEMALE

Eastman permanently attached couplings give you **a bond stronger than the hose itself!** For 1, 2 and 3 wire braid rubber cover hose.
Sizes: ¼" thru 2".
Working Pressure: 375-5000 p.s.i.

PERMANENTLY ATTACHED FLANGE HEAD COUPLINGS

A no-thread, no-leak "O" ring connection, with split flange and insert available in angles from 0°-90°, for 1 and 2 wire braid rubber cover hose.
Sizes: ¼" thru 2".
Working Pressure: 375-5000 p.s.i.

INTER-LOCK® CLAMP COUPLINGS

Exclusive Combination: Clamp-type coupling with "Inter-Lock" feature and blowout-proof split flange for 1 and 2 wire braid rubber cover hose.
Sizes: ¼" thru 2".
Working Pressure: 375-5000 p.s.i.

2-PIECE REUSABLE SWIVEL FEMALE

Increase serviceability of your original equipment with Eastman Reusable Couplings—for rubber and cotton cover hose.
Sizes: ⅜" thru 1¼".
Working Pressure: 375-5000 p.s.i.

Eastman
first in the field

MANUFACTURING COMPANY
Dept. AH-11 • MANITOWOC, WISCONSIN

WRITE FOR HIGH PRESSURE CATALOG!

Get on our mailing list to receive out latest Technical Bulletins, Catalogs and Special Inserts.

CIRCLE 45 ON TIME-SAVER CARD

LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Wants to Translate

TO THE EDITOR:

I have read *Aircraft Hydraulic Design* written by George R. Keller and published by APPLIED HYDRAULICS & PNEUMATICS. I found its contents quite instructive.

I wish to translate the book into Japanese and publish it in a local technical magazine to aid our countrymen in understanding aircraft hydraulics.

I am an engineer, 31 years old, working at the Mitsubishi Heavy Industries Reorganized Ltd., Nagoya Aircraft Engineering Works. We are manufacturing the F-86F Saber Jet under agreement with North American Aviation, Inc. Having been an interpreter I feel confident that I can convey the original meaning in the Japanese language.

K. SUENAGA
108 Mamushiga-ike
Tashiro-cho, Chigusa-ku
Nagoya, Japan

We have passed this request on to George R. Keller author of Aircraft Hydraulic Design and requested that he reply directly to you.

Basic Pneumatics

TO THE EDITOR:

Please send me information I will need for ordering the booklet, *A Beginner's Course in Basic Pneumatics*, published by APPLIED HYDRAULICS.

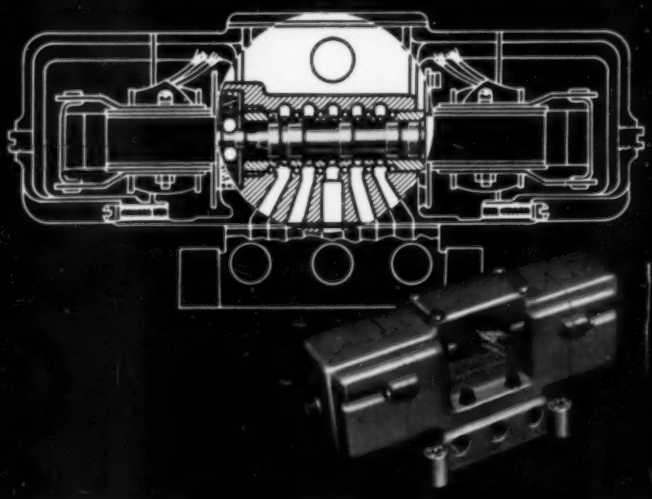
Please include information on any similar booklet you may publish on hydraulics.

ANDREW I. KESTI
Micromatic Hone Corp.
Detroit, Mich.

Copies of A Beginner's Course in Basic Pneumatics *are available at $1.50 per copy. We do not have a similar booklet on hydraulics. However, if you have a copy of the* 1958/59 Fluid Power Direc-

Continued on page 16

It's the air valve with the floating sleeve-lapped spool design



50 million cycles without a sign of wear!

This is not just a claim, it's a fact! And Numatics has the verified case histories to prove it . . . cases where Numatics SA Series valves are still performing like new after well over 50 million operations. *And not on a test bench under ideal conditions,* either, but out in the field on high speed welding guns, punch press scrap choppers, high speed packaging machines and other actual installations.

With the floating sleeve-lapped spool you can expect *and get* this kind of performance from every Numatics valve, because the spool has no seals or packers to wear out . . . it floats on a fluid film, never contacts the sleeve wall. The sleeve floats, too, on O-rings which isolate it from the valve body. Both spool and sleeve, what's more, are specially heat treated stainless steel, close-tolerance finished to minimize friction. In a nutshell, Numatics valves are designed and built to give you longer, more trouble-free life than is possible with ordinary air valves. Want a catalog? Send for it!

LOOK TO NUMATICS FOR LINE VALVES, TOO . . .

Numatics offers a complete *line of high speed, heavy duty 2-and 3-way in-line valves . . . valves you can depend on for top performance, long life, minimum maintenance and applications unlimited. And we'd like to* prove *it! May our representative call on you?*

NUMATICS, Inc. HIGHLAND, MICHIGAN

SALES REPRESENTATIVES FROM COAST TO COAST

CIRCLE 95 ON TIME-SAVER CARD

Brown & Sharpe announces:

A COMPLETE LINE OF PRODUCTS; 55 SERVICE

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WAlnut 3-8538
Logansport
Tec Engineering Corp.
LOgansport 3305
Muncie
Tec Engineering Corp.
ATlas 2-7735

KANSAS
Wichita
Baker Engrg. & Equip. Co.
FOrest 3-4246

KENTUCKY
Louisville
Chas. Weber Co.
MElrose 7-2574

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8-1834

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Colliflower, Inc.
Ellicott City
RIdgeway 4-2690
Baltimore
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VAlley 3-0813

MASSACHUSETTS
Boston (Metropolitan)
Stewart-Hunt, Inc.
Lexington
VOlunteer 2-2860
Springfield (Metropolitan)
Stewart-Hunt, Inc.
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ALpine 3-5615

MICHIGAN
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TEmple 2-4115
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J. N. Fauver Co.
CEdar 5-5392
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EXport 3-5350

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Brooklyn
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COrtlandt 7-9614
Buffalo
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Elmira Heights
R. C. Neal Co.
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Lynn Elliott Co.
CHarter 4715

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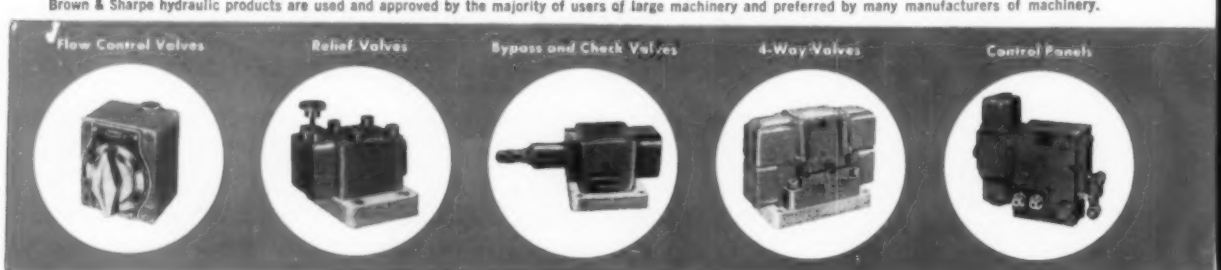
Replacement pumps and parts also available from Brown & Sharpe distributors located in all principal cities.

Brown & Sharpe hydraulic products are used and approved by the majority of users of large machinery and preferred by many manufacturers of machinery.



INDUSTRIAL HYDRAULIC & ENGINEERING OFFICES

PROVIDING YOU WITH GREATER ASSURANCE THAN EVER BEFORE OF GETTING CUSTOM-BUILT HYDRAULIC CIRCUITS WITHOUT THE EXPENSE OF CUSTOM-BUILT VALVES . . . WITH COMPLETE CIRCUIT RESPONSIBILITY FROM ONE SOURCE.

Brown & Sharpe has brought together, within our new Hydraulics Division:

Double A **hydraulic valves** — the broadest selection of fine quality, standard specification hydraulic control valves available anywhere. Double A valves are made to JIC standards for every control valve application. They offer you approximately 30% more standard-specification models to choose from than any other line, providing you greater opportunity to get custom-built hydraulic circuits without paying custom prices. Pressures to 5000 psi. Supplied with sub-plate mountings, flanged connections or threaded body connections.

GEROTOR **hydraulic pumps** — a most dependable hydraulic pump, especially with low-lubricity, non-flammable fluids. Wide range of capacities. Pressures: to 2000 psi. Used as motors, they deliver high torque at good efficiency.

Brown & Sharpe **pumps** — a broad line of vane, gear, and centrifugal pumps for handling hydraulic fluids, coolants, lubrication oils.

Brown & Sharpe **power units** — a complete, compact package to power a broad variety of hydraulic applications.

Creative hydraulics design staff — more than 130 experienced field application engineers and factory-trained representatives, backed by Brown & Sharpe's 70 years of experience in hydraulic applications.

Off-the-shelf delivery and service through offices in more than 55 principal cities throughout the country.

For product catalogs or design and application information about hydraulic components — or about completely pre-engineered hydraulic power units — contact our nearest sales representative (names and addresses listed at left) or write to Double A Products Co., a subsidiary of Brown & Sharpe Mfg. Co., Manchester, Michigan.

Brown & Sharpe

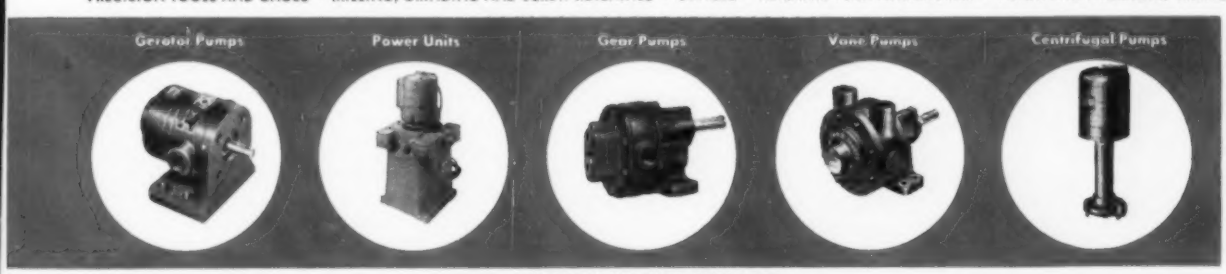
HYDRAULICS DIVISION

GEAR, VANE AND CENTRIFUGAL PUMPS
DOUBLE A VALVES
GEROTOR PUMPS
POWER UNITS

B·S

PROGRESS IN PRECISION FOR 125 YEARS

PRECISION TOOLS AND GAGES • MILLING, GRINDING AND SCREW MACHINES • CUTTERS • MACHINE TOOL ACCESSORIES • PUMPS AND HYDRAULIC VALVES



CIRCLE 20 ON TIME-SAVER CARD

A NEW APPROACH TO MACHINE PROCESS CONTROL

Step Sequencing

the new **Eagle Step Switch**

use any type of time or sensing device to advance the *Eagle Step Switch*

PUSH BUTTON

LIMIT SWITCH

INTERVAL TIMER

PRESSURE CHANGE

LEVEL CONTROL

operate a multiplicity of load circuits in any combination up to 19 circuits

This new *Eagle Step Switch* also provides:

1 SEQUENCING INTERLOCK when used with multiple indexing circuits.

2 10 AMP SWITCH CONTACTS control load switches direct — no need for load relays.

3 MECHANICAL CIRCUIT INTERLOCK by cam action — eliminates interlocking relays.

4 115 VOLT COIL operates direct on AC with heavy duty ratchet mechanism — insures long life.

EAGLE TIMERS SAVE TIME . . . SAVE MONEY

EAGLE SIGNAL CORPORATION
Industrial Timers Division,
MOLINE, ILLINOIS

MAIL COUPON TODAY

EAGLE SIGNAL CORPORATION
Industrial Timers Division, Dept. AH-1158
MOLINE, ILLINOIS

Please send Bulletin 780 containing complete data on your new Eagle Step Switch.

NAME AND TITLE

COMPANY

ADDRESS

CITY ZONE STATE

CIRCLE 43 ON TIME-SAVER CARD

LETTERS

tory, you will find it valuable. Included in this 796-page volume is a 224-page section on Fluid Power Design Data. Price per copy is $6.50.

Annual Indexes

TO THE EDITOR:

Would you kindly forward to us copies of your annual indexes for previous years? Periodically we search literature and these would be a great assistance to us.

S. L. SANDELMAN
Aero Hydraulics Div.
Vickers, Inc.
Detroit, Mich.

We are pleased to enclose all the available annual indexes for APPLIED HYDRAULICS & PNEUMATICS *Magazine. Starting this year, we are going to prepare reprints of the editorial index published in the December issue.*

Hydraulic Textbooks

TO THE EDITOR:

Do you have a data list showing where I might be able to obtain textbooks and other information concerning the oil hydraulic field? I have a data sheet published by you in 1952 and wondered if it was up to date.

FRED B. HUNTINGTON
Carbon College
Price, Utah

Attached is a photo copy of pages from our Fluid Power Directory which gives you a complete list of textbooks and films presently available in the fluid power field.

Also attached is a descriptive sheet for your information about the directory. This directory is published every two years. Price per copy is $6.50.

Boosting to 10,000 psi

TO THE EDITOR:

As a manufacturer of high pressure aircraft instruments we have the problem of testing these instruments with gas pressures to 10,000 psi.

Continued on page 18

GREER—Headquarters for All Types of Accumulators:
SEPARATOR • NON-SEPARATOR
SPRING LOADED • WEIGHT LOADED

NOW-

Make GREER Your Single-Source for All Accumulators!

No matter what your accumulator requirements may be, Greer can help you choose the right one to do the job best—because Greer is the only company that makes all types.

Greer's experience and technical know-how in the application of accumulators to aircraft, missiles and industrial equipment is unmatched in the field.

Let a Greer representative show you how Greer Accumulators simplify circuits, reduce size, weight and cost of equipment, and improve performance with complete reliability. Write or call Greer without obligation for immediate assistance.

FREE! GREER ACCUMULATOR DATA FILE. Complete information with diagrams on standard and special accumulators for aircraft, missiles and industrial equipment. Details 9 ways to use an accumulator effectively, plus other important data. A must for engineers and manufacturers.

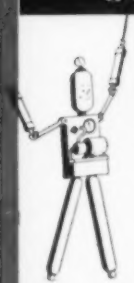
NEW! PISTON ACCUMULATORS

Greer introduces a complete line of competitively priced standard Piston Accumulators available for prompt delivery. Special design and construction gives extra safety because it is impossible to disassemble the accumulator while it contains a precharge.

Wherever standard piston accumulator performance is desired, specify the Greer Piston Accumulator for all your industrial applications.

Specifications: 3000 psi operation. 9 models from 10 cu. in. to 2250 cu. in. oil capacities. Operating temperature range −65° to +425°F. Available for use with most types of fluids, gases, etc., high or low temperatures, as specified.

A COMPLETE RANGE OF SIZES IN BOTH TYPES



BLADDER ACCUMULATORS

Unmatched Reliability and Versatility
PLUS ONE YEAR WARRANTY!*

The famous Greer Bladder Accumulator is unmatched for all-around dependability and long-run economy. Proof of utmost reliability and acceptance is in its diversified usage: planes, ships, missiles, submarines, buses, construction machines, pipelines—and many other industries.

Greer Bladder Accumulators meet all J.I.C. and I.C.C. safety standards and are approved for installations under all applicable state, municipal and industrial safety codes. Also easiest to install with lowest maintenance cost.

Specifications: 8 models from 1.5 cu. in. to 2080 cu. in. oil capacities. Two operating pressure ranges: 0-3000 psi and 0-6000 psi. High and low operating temperature for use with most types of fluids, gases, etc.

*See your Greer representative for details on this exclusive warranty.

Sold and distributed by

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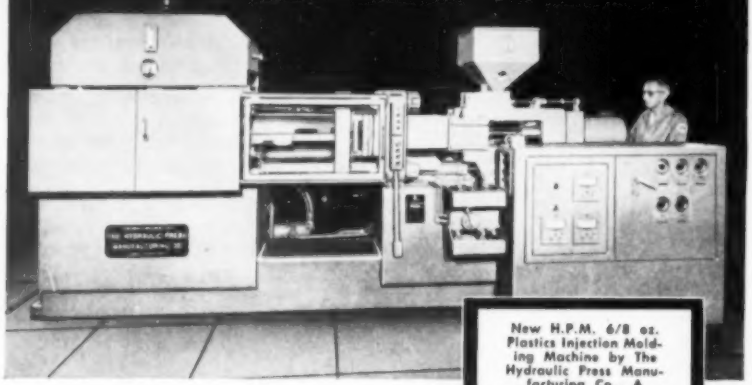
ENGINEERS: Resumes invited for stimulating careers in fluid systems

CIRCLE 58 ON TIME-SAVER CARD

Young

HIGH PRESSURE HEAT EXCHANGER

Solves Cooling Problems on High Speed Injection Molding Machine!



New H.P.M. 6/8 oz. Plastics Injection Molding Machine by The Hydraulic Press Manufacturing Co., A Division of Koehring Co.

Young Model HF

Heat Exchanger cools Hydraulic Fluid under high pressures

Type HF Two-Pass Heat Exchanger

Built for the packaging and like industries, this new high-speed plastics injection molding machine has a tremendous capacity. Full clamp stroke at 720 cycles per hour, and as many as 900 cycles per hour with reduced stroke. Continuous operation at such high speeds is made possible by the use of a Young Type HF (High Pressure) heat exchanger which keeps the hydraulic fluid at the correct temperature for most efficient operation. One of over 400 standard models, a Young Type HF Heat Exchanger is used here for working pressures of 150 psi on the tube side and 250 psi on the shell side, at maximum temperature ratings of 350F. Besides having over 400 "stock answers" to heat transfer problems. Young designs and builds special heat exchangers to meet any requirements.

Write Dept. 448-L for Catalog No. 1258

Young RADIATOR COMPANY

RACINE, WISCONSIN

Creative HEAT TRANSFER ENGINEERS

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

CIRCLE 143 ON TIME-SAVER CARD

LETTERS

It is specified that the instruments must be free of contamination. The gas must be dry and oil-free.

We are now using an accumulator type booster unit, which is capable of boosting nitrogen in two stages from 500 to 6000 psi and from 6000 to 10,000 psi.

This booster unit is not entirely dependable and we are looking for other methods of obtaining moisture free gas in small volumes at pressures to 10,000 psi.

Would you know any manufacturers of this type equipment?

R. TOLLEFSEN
United States Gauge
Sellersville, Pa.

A list of the companies that may be able to help you has been sent.

Missile and GSE Issue

TO THE EDITOR:

You certainly covered a lot of ground in the fluid power for missiles and ground support equipment field and a lot of excellent people in the best American companies and laboratories cooperated. Congratulations.

ARTHUR F. JOY
Raytheon Manufacturing Co.
Waltham, Mass.

We want to thank the many engineers who wrote us about the issue and requested additional copies. Sorry that we can't fill any more requests. Our complete overrun of this September Missile and GSE issue was exhausted by October 1st.

January Guide Issue

TO THE EDITOR:

Your third annual Designer's Guide Issue is due on my desk in January. That's the one where you do my job for me by charting characteristics of major fluid power products made by some 500 companies. This year I'd like to keep my copy from migrating elsewhere in our company. Can I reserve extra copies?

JOHN PAVOLI
Caterpillar Tractor Co.
Peoria, Ill.

Bless your heart! See page 146 in this issue for complete information about the January 1959 issue.

More reasons why OEM designers specify

THE BELLOWS AIR MOTOR

—the air cylinder with the built-in valve

- **no extra valves—all operating controls are built-in**
- **choice of valve types: low voltage, JIC, pilot-actuated, mechanically actuated**
- **responds to starting impulse instantly—no lag, no stutter**
- **fits well in tight quarters, on moving machine elements**
- **no cumbersome piping, requires only a single air connection**
- **available in five bore sizes: 1¼, 1¾, 2½, 3⅛, 4½"**
- **made in any stroke length**
- **over 150 skilled field engineers the world over to handle your fluid power requirements.**

They all add up to:

LESS DESIGN TIME REQUIRED,
LOWER FACTORY COST TO INSTALL!

Get this Booklet!

"The Bellows Air Motor in Original Equipment Design." Write Dept. AH-1158, The Bellows Co., Akron 9, Ohio.

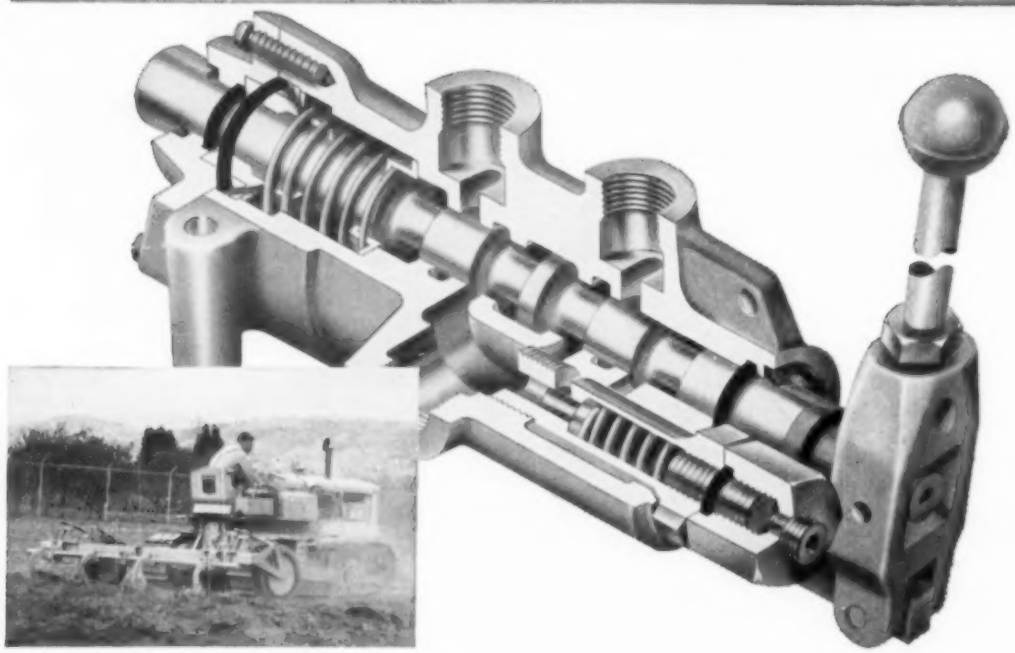
The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION
AKRON 9, OHIO

1221-B

CIRCLE 18 ON TIME-SAVER CARD

NATIONAL OIL SEAL LOGBOOK



Use of O-rings as moving seal in heavy duty bulldozer control valve

1,500 psi variation without backup rings. Intermittent operation plus long periods of inactivity. Extreme external dust and dirt conditions. Irregular and unpredictable field servicing. Fluid oil temperatures reaching 180°F. Climatic temperature extremes from —30° to +120°F. Life expectancy is required to be that of the tractor.

Above are the rugged operating conditions faced and met by National industrial O-rings in the new Be-Ge Model SU-1200F bulldozer blade control valve. A total of four rings are employed in each unit; two in a moving shaft application and two as static seals.

Be-Ge reports no leakage or ring failure on hundreds of heavy duty applications involving Oliver, Caterpillar, International Harvester and other crawler tractor installations.

National offers a complete line of industrial O-rings, plus many exclusive compounds. Special compounding is also available to meet unusual conditions.

For complete information on National O-Rings, or for skilled O-ring engineering service, call your nearest National Seal engineer. In major cities nationwide. See the Yellow Pages, under "Oil Seals".

Syntech® Oil Seals

Syntech oil seals, developed by and offered exclusively by National, are widely used synthetic rubber seals for applications where temperatures reach 250°F, speeds reach 3,600 FPM, and total indicator runout is as high as .030. Basic 50,000 series Syntech (illustrated) employs a tough, accurately manufactured steel outer case, precision-tensioned spring and accurately molded and trimmed Syntech sealing lip.

Micro-Torc Oil Seals

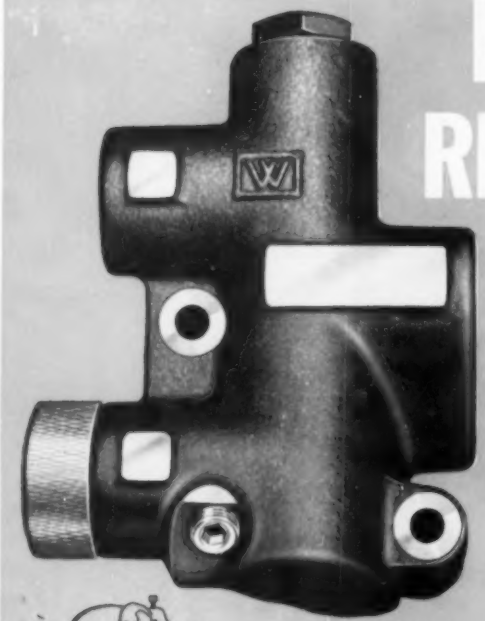
Micro-torc oil seals, pioneered by National, are sturdy, dependable leather seals. Special elastomer coating on *surface* of chrome re-tanned leather sealing lip prevents seepage of oil. Yet inner body of sealing lip retains natural porosity to "store" lubricant against accidental periods of starvation. Inherent lubricity of elastomer coating produces a lower torque, longer lasting, economical oil seal. Available in a wide variety of types and sizes.

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

4624

CIRCLE 93 ON TIME-SAVER CARD

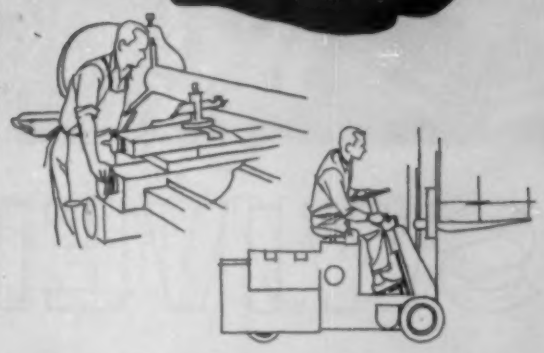
NEW FROM WEBSTER PILOT OPERATED RELIEF VALVE



with manually adjustable PRESSURE SETTINGS

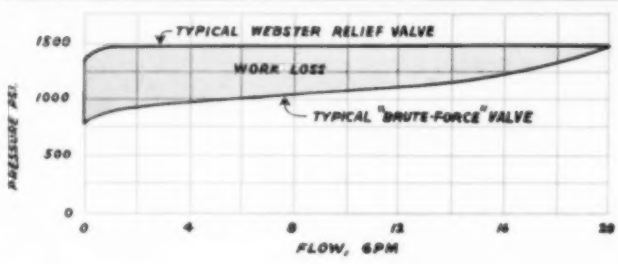
INSTANT ADJUSTMENT of pressure settings makes Webster's new pilot operated relief valve an ideal and *wise* choice for industrial applications. Knurled knob permits quick manual changes in pressure settings . . . from 500 to 2000 psi. Valve is also available with adjusting screw and sealing cap instead of knurled knob. Both models are available in two sizes — 0 to 20 gpm and 0 to 60 gpm.

In addition, there are the proved advantages of Webster's clog-free performance, quieter operation, quality construction . . . at a price competitive with the lowest.



BOOSTS WORK OUTPUT 38.5%!

Full speed power up to 93% of relief setting with the Webster pilot operated relief valve! And the graph shows it . . . typical performance curve illustrates minimum pressure drop and instant response of Webster pilot valve over "brute-force" type. 38.5% work bonus!



call the man from Webster

His intimate knowledge of this new relief valve and its many advantages can help in adapting it to your product.

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

RACINE · WIS

- ☐ *Have THE MAN FROM WEBSTER contact us — — Please send the following:*
- ☐ *Bulletin H3A3 covering the new Webster pilot operated relief valve*
- ☐ *Complete hydraulic catalog of pumps, valves and fluid motors*
- ☐ *New information or data as published*

Name.....

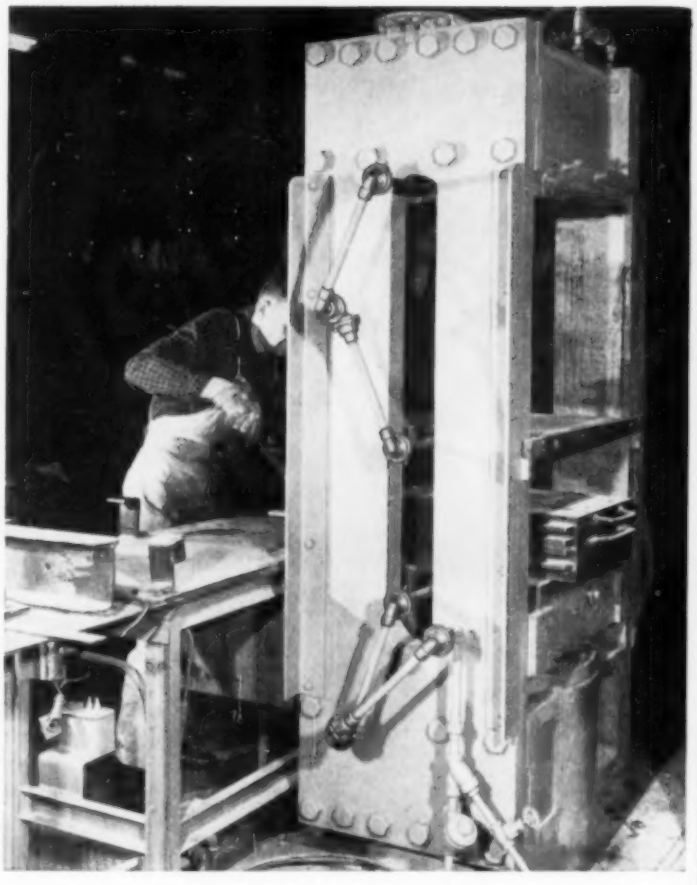
Title.....

Company.....

City..... State.....

CIRCLE 140 ON TIME-SAVER CARD

STEEL LINES FOLD LIKE AN ACCORDION
Typical of diverse swivel joint applications, newly designed Chiksan Discpak joints are installed on the steam lines of a platen press. This new type swivel joint, designed for hot gas and steam, allows inexpensive packing replacement without removing swivel joint from line.



WHEN *design*
DICTATES
METAL LINES . . .

SOLVE LINE FLEXING PROBLEMS

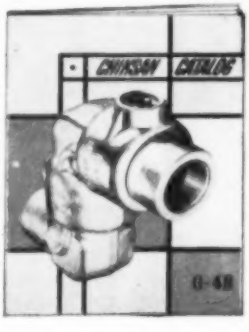
with **CHIKSAN SWIVEL**

Chiksan swivel joints allow metal lines to be flexed in predetermined travel arcs, eliminate hose rupture, reduce maintenance and replacement costs.

Where tight bends in pressure hose make wide loops necessary, Chiksan swivel joints, conversely, permit compact placement of lines. When used with hose, Chiksan swivel joints shorten hose lengths and also lengthen hose life by minimizing tight bend and torsional fatigue.

Chiksan swivel joints are available from stock in a wide range of materials, temperatures, and pressures to meet practically every design requirement. Chiksan swivel joint packing units are designed for specific services. For example, packings have been developed to efficiently handle non-inflammable hydraulic fluids. Write today for catalog and name of nearby sales engineer.

LONG SERVICE LIFE ➤
Chiksan swivel joints deliver years of service with only occasional maintenance attention. All-steel hydraulic lines on Flash-Butt welder, shown at right, allow lines to shift as machine is adjusted to handle various work.

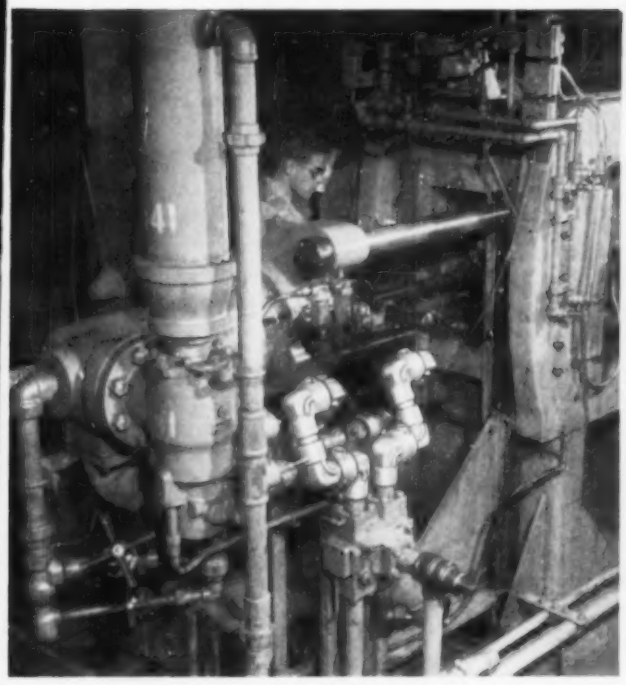


A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

fmc CHIKSAN

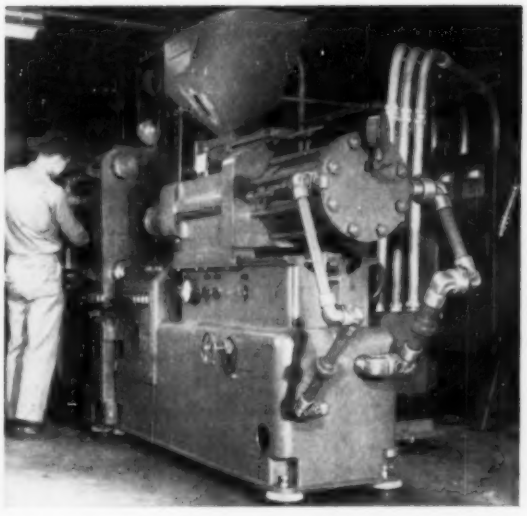
CHIKSAN COMPANY—BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries Chiksan Export Company • Chiksan of Canada Ltd



NO HOSE BURST DANGER HERE...

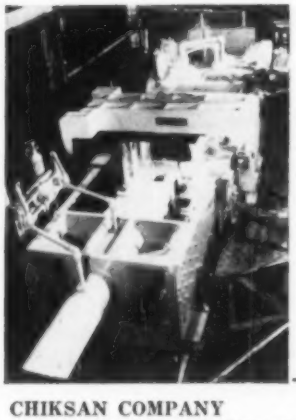
Critical lines take on a new measure of safety with all-steel flexible units replacing pressure hose. These all-metal swivel jointed lines shown on a die casting machine above, eliminate damaging hose ruptures, and reduce fire hazard, fluid loss and setup time by 75%.



PRESSURE? TEMPERATURE? CHIKSAN MEETS THE NEED...

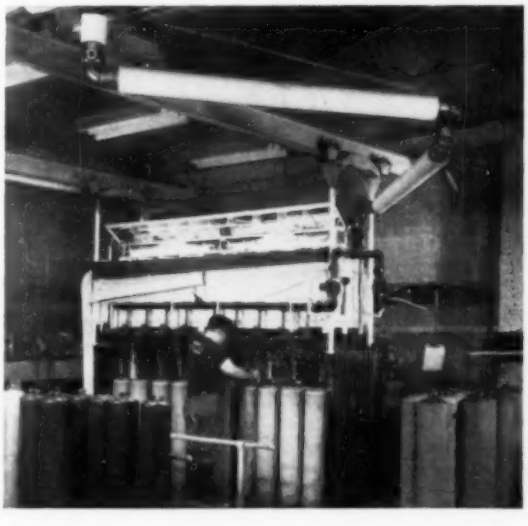
Over 2,000 different types, styles and sizes in a variety of temperature and pressure ratings are available to meet your design needs. This plastic injection molding machine, above, uses two different sizes of Chiksan swivel joints on its hydraulic lines.

JOINTS



NO LIMIT ON LINE DESIGN

Free swiveling action in 1, 2 and 3 planes permits design of compact lines to meet any requirement. This overhead line in service at a water softener regenerating plant permits shift from one setup of tanks to another for faster handling of tank regeneration.



#58-31

CHIKSAN COMPANY
330 NORTH POMONA AVENUE, BREA, CALIFORNIA

Please send me copy of your latest catalog

Name_____ Company_____

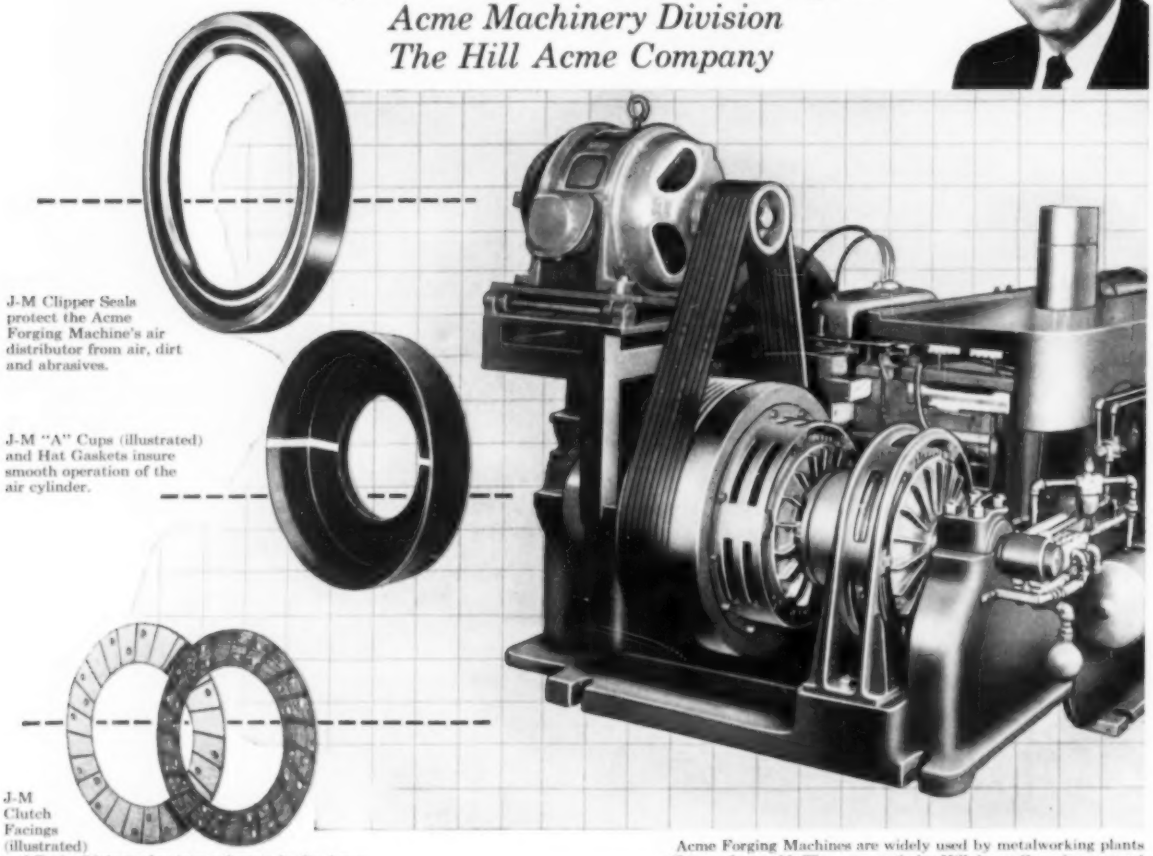
Title_____ Address_____

City_____ Zone_____ State_____

CIRCLE 28 ON TIME-SAVER CARD

"Customer satisfaction hit a new high when we redesigned Acme forging machines with J-M Packings and Friction Materials,"

says M. W. Lamprecht, Chief Engineer
Acme Machinery Division
The Hill Acme Company



J-M Clipper Seals protect the Acme Forging Machine's air distributor from air, dirt and abrasives.

J-M "A" Cups (illustrated) and Hat Gaskets insure smooth operation of the air cylinder.

J-M Clutch Facings (illustrated) and Brake Linings play integral parts in the Acme Forging Machine's cushion drive mechanism.

Acme Forging Machines are widely used by metalworking plants all over the world. They are made by Hill Acme Co., pioneers and leaders in construction and design of modern forging machines.

J-M products defy extreme thermal and mechanical shock for dependable performance and long life

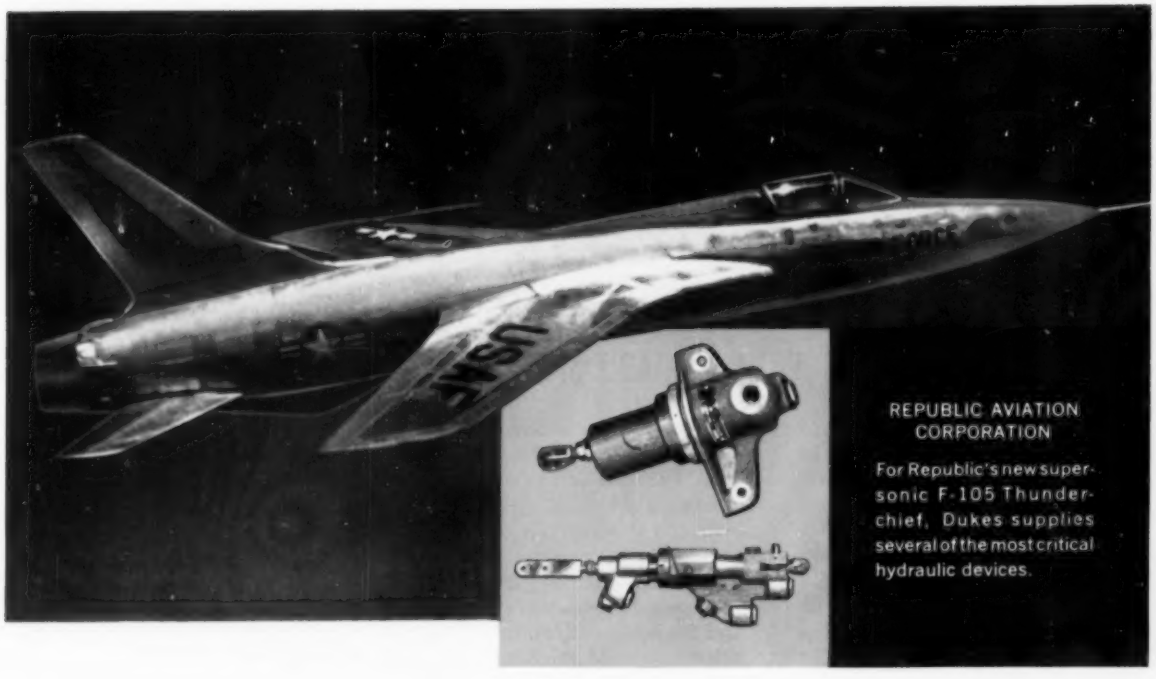
In terms of thermal and mechanical shock and the constant presence of dirt, chips and other abrasives, Acme Forging Machines provide one of the most rugged tests ever devised for packings and friction materials. In more than 20 years of service, Johns-Manville products have achieved an enviable record with Acme users. Performance has been more than satisfactory in every way and replacement has been held to the minimum.

Johns-Manville makes a complete line of packings, gaskets, asbestos textiles, brake linings, clutch facings, transmission bands and industrial friction materials. Chances are one or more of these products may provide the answer to your design problems. For further information call your local J-M sales office or write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE

JOHNS MANVILLE JM PRODUCTS

CIRCLE 77 ON TIME-SAVER CARD



REPUBLIC AVIATION CORPORATION

For Republic's new supersonic F-105 Thunderchief, Dukes supplies several of the most critical hydraulic devices.

When low cost is important, and quality essential . . .

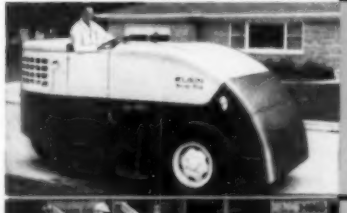
Let Dukes quote on your hydraulic "specials"

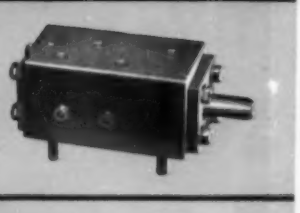
Custom-made to specifications furnished, Dukes cylinders and valves are helping build dependability into these and many other trusted products. Let us prove that you can get the quality and delivery you want at the lowest possible price—from Dukes.

Send for complete new catalog on standard valves

This servo valve is just one of the many Dukes valves incorporated in the new Elgin Street King sweeper.

THE ELGIN CORP.





JOHN DEERE

John Deere loaders are built for reliability — Dukes manufactures the Super Duty cylinders for them.

DUKES HYDRAULICS

Dukes Company Inc. • 3999 N. 25th Avenue • Schiller Park, Ill. • A Chicago Suburb

CIRCLE 41 ON TIME-SAVER CARD

BRIEFS

about fluid power

HYDRAULICS COMBINES WITH VARIABLE-SPEED ELECTRIC MOTOR

This new profile milling and contouring machine, developed by Ekstrom, Carlson & Co., Rockford, Illinois, uses a 3-dimensional hydraulic feed system and a variable-speed electric motor spindle drive.

• **Hydraulic control**—The 3-dimensional feeds are accomplished through hydraulic cylinders that are operated by a tracing control valve. The tracing control valve contains three, 4-way valves. Horizontal movement of the tracing finger is transmitted to the two horizontal valve spools through a scotch yoke. Vertical movement of the tracing finger is directly transmitted to the vertical spool. The cross rail carries the compound cross-slide which is operated by hydraulic cylinders for cross and vertical head movements. A second depth tracer (180 deg) is provided for controlling depth when rise and fall is not desired. By shifting a hand-operated valve, this tracer is put in operation and the rise and fall movement is isolated from the 3-D tracer.

• **Electric spindle drive**—The spindle drive has a speed range of 50 to 6000 rpm. Speed range at constant torque is 50 to 1500 rpm and at constant horsepower, 1500 to 6000 rpm. Both thyraton armature control and magnetic amplifier field weakening control are used. The motor is water cooled and is rated at 10 horsepower. The control unit meets JIC, NMTBA and NEMA standards. ▼▼▼

Philadelphia ASME Holds Fluid Power Meeting

On November 24 at the Engineers' Club in Philadelphia the ASME will hold a meeting of the Fluid Power Division. Hydraulics in a Progress-Through Machine is the title of a paper to be given by Arthur B. Riddiford, Jr., Chief Engineer of machine tool hydraulics, John S. Barnes Corp., Rockford, Ill. Riddiford holds an ME degree from Cornell. He has made many contributions to the fluid power field and has lectured before technical groups and colleges on the subject. ▼▼▼

Electro-Hydraulic Hoists Are Servo Controlled

Hoists are made in capacities of ¼ to 2 tons and can lift material 10 ft. They feature precision positioning, adjustable speed, one hand operation, and finger-tip control. The entire powering mechanism for the hoist is in the overhead trolley assembly. An electric motor drives a hydraulic gear pump. Fluid pressure is maintained by an accumulator, allow-

Continued on page 28

Bet your boots we make 'em

Steering knuckle drag link boot
Universal joint cover
Bellows cover for sliding ways
C/R
Coated fabric cylinder rod boot
Hydraulic jack cylinder rod boot

Custom-designed and engineered to fit mechanical giants or midgets

Whether you want a boot two stories high . . . or no bigger than your thumb . . . let C/R Sirvis engineers solve the problem for you. They're specialists . . . backed by 78 years' experience . . . with unusual skills and ingenuity in the development and manufacture of mechanical boots. They'll design and produce a C/R Sirvis boot to your exact requirements in any size, any quantity . . . using only the finest materials: mechanical leather, selected, tanned and treated by C/R . . . nylon . . . or elastomer-coated fabric. The absolute dependability of your boot will be proved before production.

So, whenever your problem involves the protection of eccentric, reciprocating or universal action . . . call on C/R. Write us for complete information.

CHICAGO RAWHIDE MANUFACTURING COMPANY
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Offices in 55 principal cities. See your telephone book.

In Canada: Distributed by Chicago Rawhide Mfg. Co. of Canada, Ltd., Brantford, Ontario

Export Sales: Geon International Corp., Great Neck, New York

SIRVIS C/R DIVISION
CHICAGO RAWHIDE

Other C/R Products
C/R Shaft & End Face Seals • Sirvene (synthetic rubber) molded pliable parts • C/R Non-metallic Gears

CIRCLE 27 ON TIME-SAVER CARD

CONTROL MANUFACTURERS

Typical installation shows Brunner compressors providing a dependable source of compressed air for operating pneumatic control of the large air conditioning system in New York's Socony Mobil Building.

PREFER BRUNNER SINCE 1906

AIR COMPRESSORS
for 6 good reasons

Looking for a reliable, economical source of compressed air? Take a tip from leading control manufacturers who prefer and select Brunner air compressors.
They'll tell you . . . BRUNNER Air Compressors

- Are outstandingly dependable
- Provide oil and moisture free air
- Offer single or 2 stage equipment in all sizes
- Supply complete air or water cooled aftercooler assemblies with all fittings from one dependable source for all compressor sizes
- Provide "entire system" duplex units that are "operation readied" to connect to piping and wiring facilities
- Air conditioning and heating experience of Dunham-Bush engineers enables them to professionally assist in layout for dependable control systems.

ALSO WATER COOLED AFTERCOOLERS AND OTHER ACCESSORIES BY heat-x A DUNHAM-BUSH SUBSIDIARY

WRITE FOR NEW BRUNNER AIR COMPRESSOR CATALOGS

You'll find full information on the use of compressed air; data that indicates the right compressor for a specific job; tables of computations for correct installation.
Ask for Catalog #36 for a guide to ½ through 20 H.P. Brunner Air Compressors.
For Brunner 25-30-40-50 H.P. industrial air compressor data, ask for catalog #37.

BRUNNER DIVISION
DUNHAM-BUSH, INC.
DEPT. AA. WEST HARTFORD 10, CONNECTICUT

CIRCLE 42 ON TIME-SAVER CARD

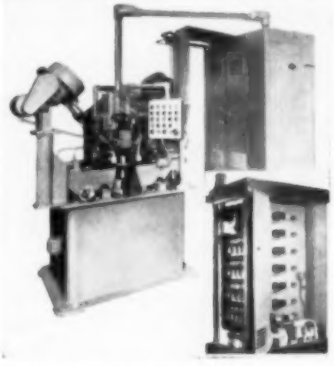
BRIEFS

ing from two to three lifts between each motor-running cycle.

Load supporting fluid is isolated from the hydraulic system by a spool-type control valve. A suspended load up to full capacity

will remain fixed safely in position should power fail. Even without power the load can be safely lowered to the floor. Manufactured by Automatic Warehousing Branch, Pesco Products Div., Borg-Warner Corp., Bedford, Ohio, the units are moved transversely by a hydraulic motor. All movements are controlled from a single handle. ▼▼▼

Continued on page 30

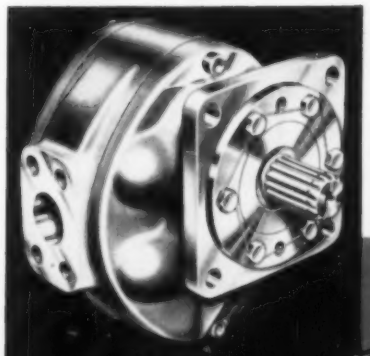


HYDRAULICALLY-OPERATED combination press and stake machine has electrical controls, hydraulic pump, reservoir and valves all contained in one control console. Designed by Gray Equipment Co., Dearborn, Mich., the machine saves space by keeping hydraulic lines to a minimum.

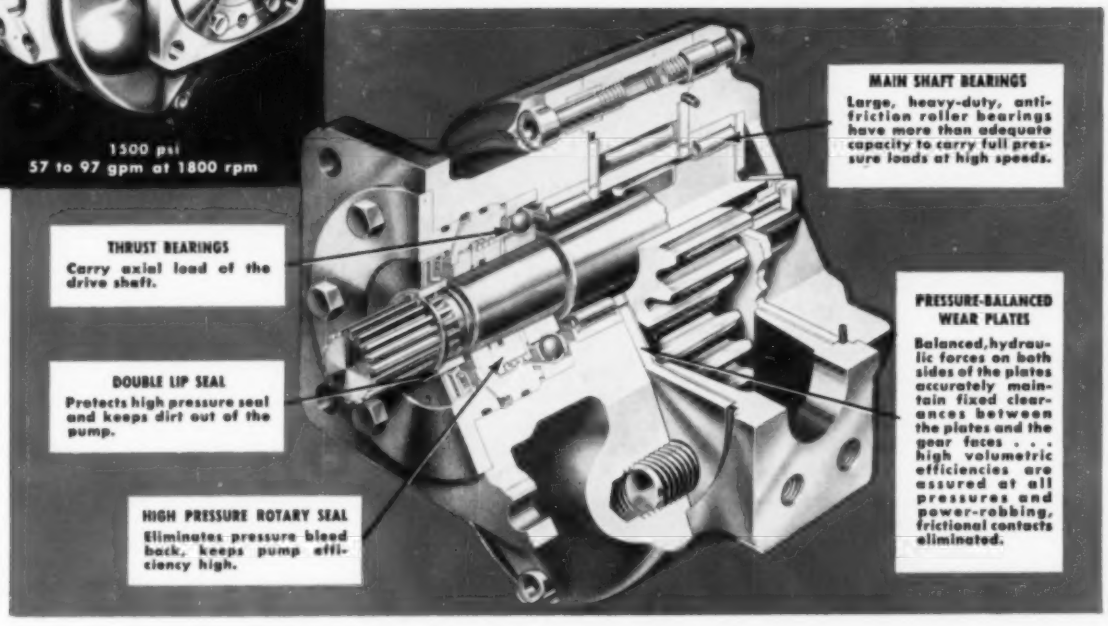
NOW • Added Service Life for the Accepted Leader Among Heavy Duty Fluid Power Pumps

HYDRECO

Series 3000K FLUID POWER PUMPS



1500 psi
57 to 97 gpm at 1800 rpm


MAIN SHAFT BEARINGS
Large, heavy-duty, anti-friction roller bearings have more than adequate capacity to carry full pressure loads at high speeds.
THRUST BEARINGS
Carry axial load of the drive shaft.
DOUBLE LIP SEAL
Protects high pressure seal and keeps dirt out of the pump.
HIGH PRESSURE ROTARY SEAL
Eliminates pressure bleed back, keeps pump efficiency high.
PRESSURE-BALANCED WEAR PLATES
Balanced, hydraulic forces on both sides of the plates accurately maintain fixed clearances between the plates and the gear faces . . . high volumetric efficiencies are assured at all pressures and power-robbing, frictional contacts eliminated.

APPLICATIONS

EARTH MOVING EQUIPMENT
CONSTRUCTION MACHINERY
MATERIALS HANDLING EQUIPMENT
AGRICULTURAL MACHINERY
MOBILE and GENERAL
INDUSTRIAL EQUIPMENT

Member NFPA

The basic design of HYDRECO Fluid Power Pumps has been proven in thousands of successful installations . . . on Earth Moving, Materials Handling and Agricultural equipment . . . where dependability, efficiency and ruggedness are of prime consideration. *Now,* this famous design has been refined by improvements that give you this outstanding performance PLUS – *substantially extended service life – three times greater!* Translated in terms of dollars and cents, this greater service life adds value to the Pumps you buy and pays your customers extra dividends on their investment.

Check the features shown above . . . combined, they enable HYDRECO Series 3000K Pumps to set new standards in performance, efficiency and trouble-free service.

Write –

for performance and installation data on HYDRECO 3000K Series Fluid Power Pumps.

Hydreco Division
The New York Air Brake Company
9004-11 East Michigan
Kalamazoo, Mich.

Please send me complete information on HYDRECO Series 3000K Pumps.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

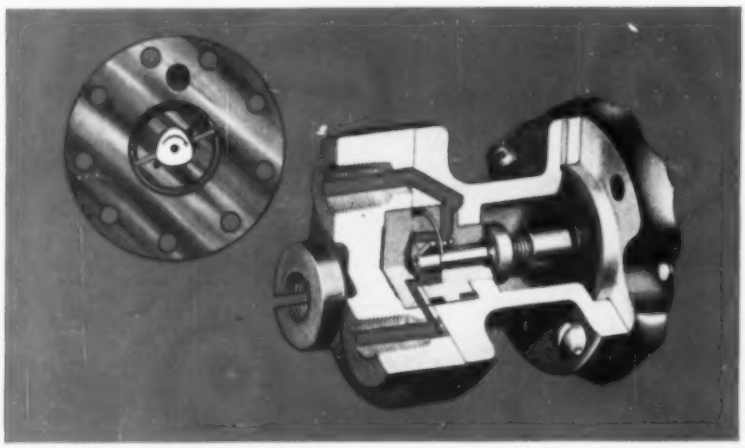
HYDRECO DIVISION
THE NEW YORK AIR BRAKE COMPANY
KALAMAZOO • MICHIGAN

CIRCLE 74 ON TIME-SAVER CARD

YESTERDAY'S PIONEER . . . TODAY'S LEADER

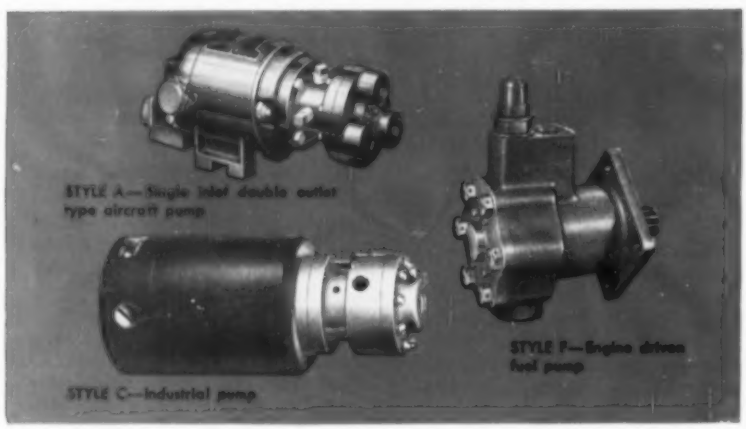
WELDON / FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.



COMPACT • LIGHT WEIGHT

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

40 YEARS OF LEADERSHIP 1910—1950

THE WELDON TOOL COMPANY

3000 WOODHILL ROAD . . . CLEVELAND 4, OHIO

CIRCLE 141 ON TIME-SAVER CARD

BRIEFS

Hydraulic Tongs Ease Pipe Handling

There has been a rapid trend to hydraulically-operated surface equipment around oil wells. One reason is the high horsepower and infinitely-variable speed control in present day high-pressure hydraulic systems.

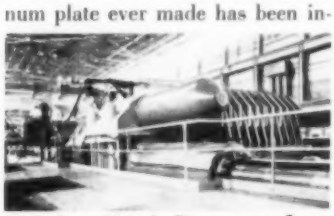
A typical use is in the Mason-Carlton casing tongs which handle

casings to 13⅜ in. dia. Powered by a 2000-psi vane motor the unit will exert 20,000 ft-lbs of torque.

Power for the hydraulic system is supplied from a 2000-psi pump driven by a gasoline engine through a 2-speed transmission. Opening and closing of the tongs is controlled by a manually-operated 4-way valve. Torque is adjusted by the setting of a relief valve. ▼▼▼

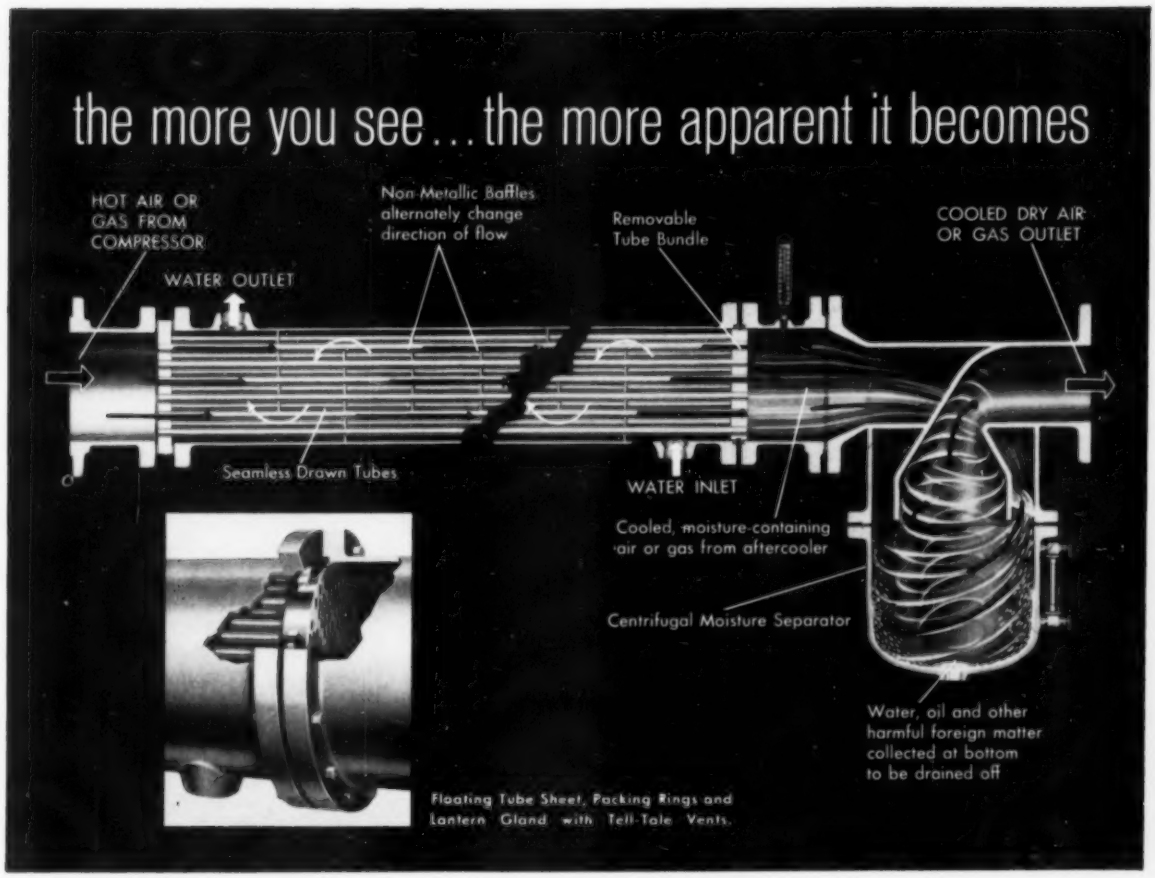
Fluid Power Stretches Aluminum Plate

The widest stretcher for aluminum plate ever made has been in-



stalled at Alcoa's Davenport, Iowa plant. It is over 150 ft long and weighs 5,000,000 lbs. The

Continued on page 32


the more you see... the more apparent it becomes
HOT AIR OR GAS FROM COMPRESSOR
WATER OUTLET
Non-Metallic Baffles alternately change direction of flow
Removable Tube Bundle
COOLED DRY AIR OR GAS OUTLET
Seamless Drawn Tubes
WATER INLET
Cooled, moisture-containing air or gas from aftercooler
Centrifugal Moisture Separator
Water, oil and other harmful foreign matter collected at bottom to be drained off
Floating Tube Sheet, Packing Rings and Lantern Gland with Tell-Tale Vents.

NEW ROSS PIPELINE AFTERCOOLERS

are today's most effective means of cooling and drying compressed air

Here, cut away for your inspection, is the new Ross Type A-100 Pipeline Aftercooler . . . the "inside story" with everything revealed.

Note how the air in the tubes flows counter to the water in the shell so that the coldest (incoming) water serves the coldest (outgoing) air. Note, too, how the air is baffled into a swirling eddy within the moisture separator to force (centrifugally) water and all other entrainment from the line.

Examine every feature! The more you see, the more apparent it becomes: *This new aftercooler is the most efficient unit ever built for air compressor service.*

Equally important is the fact that fully standardized parts are utilized to eliminate costly "specials" in both engineering and fabrication. You save in every way.

Compact and easy to install, a Ross A-100 can be readily fitted into any compressed air system. There are 51 models to choose from, with capacities ranging from 0 to 36,000 scfm at operating pressures up to 150 psig for single or two stage compression.

Why not see all there is to see? New Bulletin 302.6K1 contains the complete, illustrated story as well as specifications. Send the coupon for your copy now.

American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard
ROSS HEAT EXCHANGER DIVISION

CIRCLE 10 ON TIME-SAVER CARD

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TO
American-Standard
Ross Heat Exchanger Division
Buffalo 5, N. Y.

SEND your new Bulletin 302.6K1 describing Ross Type A-100 Pipeline Aftercoolers.

NAME _____
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AM 1158

They're Here!

NEW ADDITIONS TO THE

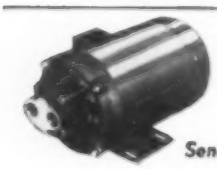
ROPER T SERIES

COMPACT, INTEGRAL PUMP AND MOTOR UNITS
For Hydraulic, Pressure Feed, Transfer Work

.3 to 55 GPM
Pressures to 400 PSI

NOW...A CHOICE OF 192 MODELS

Roper has expanded its line of Series T rotary pump units to take care of a wider range of uses pumping clean liquids. These "all-in-one" units, with pump serving as the end bell of the motor, are easily installed and have minimum space requirements . . . no coupling is required . . . each unit is approximately same size as standard NEMA motor of HP required for driving. For your specific application consult the Roper representative in your vicinity.



- COMPLETE, COMPACT UNITS
- LOW FIRST COST
- MOUNT IN ANY POSITION
- LONG LIFE SERVICE
- LIGHT WEIGHT

Roper Series T units are available in short, low and larger units with open drip proof or totally enclosed motors, single or three phase as required. Typical applications include: hydraulic door openers, work table movement, hospital beds, dental chairs, general transfer, as well as metering jobs on a wide variety of applications.

Send for Bulletin 31

ROPER HYDRAULICS, INC.
711 Blackhawk Park Avenue
Rockford, Illinois

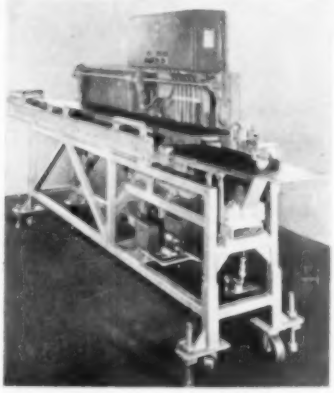
ROPER
ROTARY PUMPS

CIRCLE 113 ON TIME-SAVER CARD

BRIEFS

main ram is hydraulically operated.

Made by Loewy-Hydropress Div., Baldwin-Lima-Hamilton Corp., Philadelphia, Pa., it can grip aluminum plate to 6 in. thick and 152 in. wide and stretch and straighten it at a rate of 24 in. per min, with a pull of 16-million lbs. It is push-button operated by one man from a control desk. Stretch-straightening can be done by either setting the pressure for a certain stress in the plate, or by stretching the plate to a set length by adjusting the stroke limit. The plate is stretched beyond its elastic limit, redistributing stresses over the plate's cross-section, eliminating warpage and distortion while increasing its strength. ▼▼▼



AUTOMATIC FEEDER for heavy flat strip stock is portable and can be rolled directly to the press it feeds. Made by Press Automation Systems, Inc., Centerline, Mich., the unit is controlled by air. Strip stock is rolled manually into a preload station and automatically lowered to a feeding station by air cylinder operated arms. The electrical controls allow it to be tied into the press cycle for fully automatic feeding.

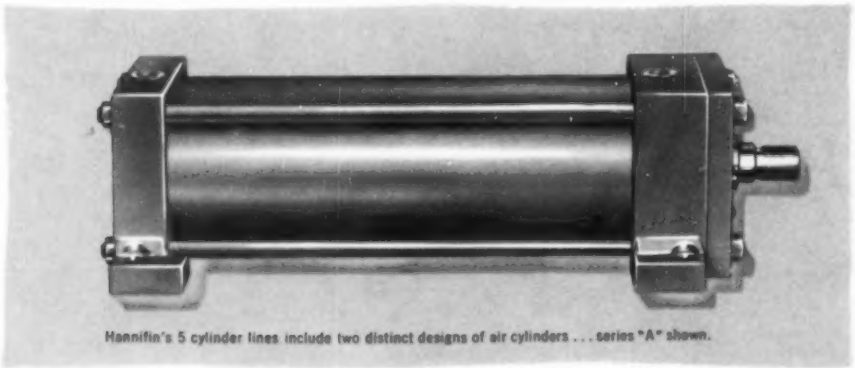
Hydraulic Motors Index Grinder

Unit has four stations for rough and finish grinding head-bearing sections of rock bits for mining. It will handle bits from 3½ to 9⅞ in. Designed by Mattison Machine Works, Rockford, Ill., the grinder

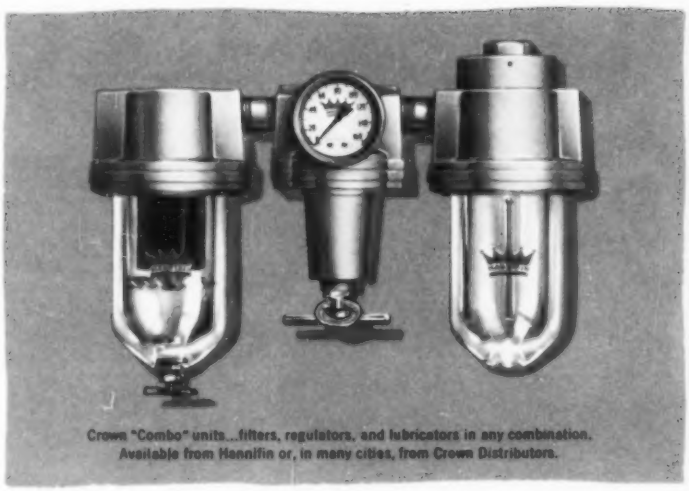
Continued on page 36

CIRCLE 100 ⟶

PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS



Hannifin's 5 cylinder lines include two distinct designs of air cylinders . . . series "A" shown.



Crown "Combo" units...filters, regulators, and lubricators in any combination. Available from Hannifin or, in many cities, from Crown Distributors.

Only **HANNIFIN** makes all these **AIR POWER COMPONENTS**

Hannifin valves take many forms. This ⅜" 4-way valve out-performs many a competing ½" valve.

Anywhere you use compressed air to do work, Hannifin can help you. Hannifin cylinders for the "muscles". . . Hannifin air valves for any type of actuation, hand, foot, cam, solenoid, or pressure . . . the Hannifin "Crown" Line of filters, regulators, and lubricators for lasting air power efficiency . . . all are built by Hannifin to just one standard, the best.

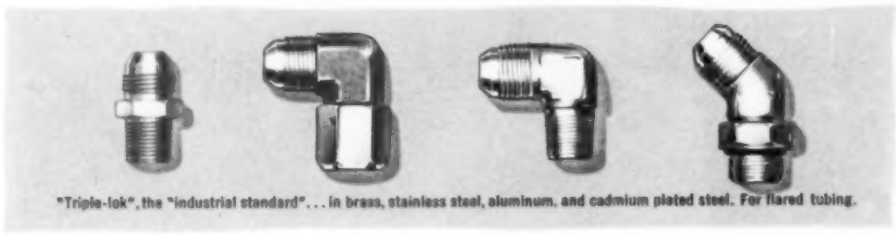
Turn to Hannifin, too, for expert help in applying air power components. A Hannifin field engineer is as close to you as your telephone, wherever you are. Write us for his address—or, he's listed in the alphabetical section of Thomas Register. It's that easy.

HANNIFIN COMPANY

505 South Wolf Road • Des Plaines, Illinois

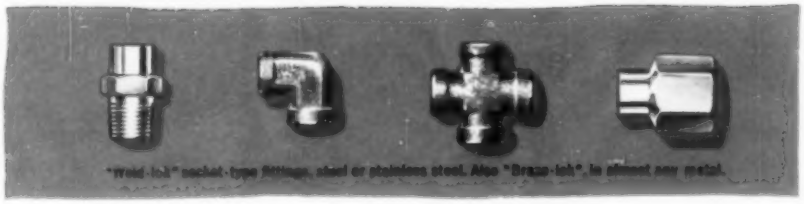
A DIVISION OF PARKER-HANNIFIN CORPORATION

PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS

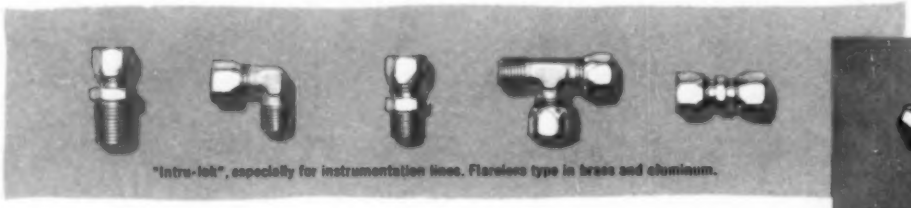


"Triple-lok", the "industrial standard"... in brass, stainless steel, aluminum, and cadmium plated steel. For flared tubing.

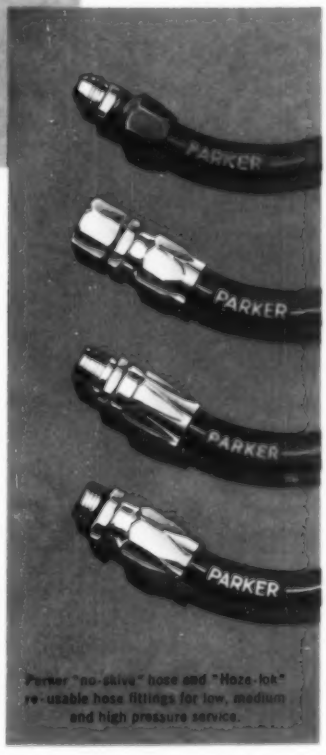
"Ferulok"®, the flareless type with the visible "bite", especially for heavy-wall tubing... in steel and stainless steel.



"Weld-lok" socket-type fittings, steel or stainless steel. Also "Braze-lok", in almost any metal.



"Intru-lok", especially for instrumentation lines. Flareless type in brass and aluminum.



Parker "no-skive" hose and "Hoze-lok" re-usable hose fittings for low, medium and high pressure service.

Only from Parker

such a wide range of fittings...so fast

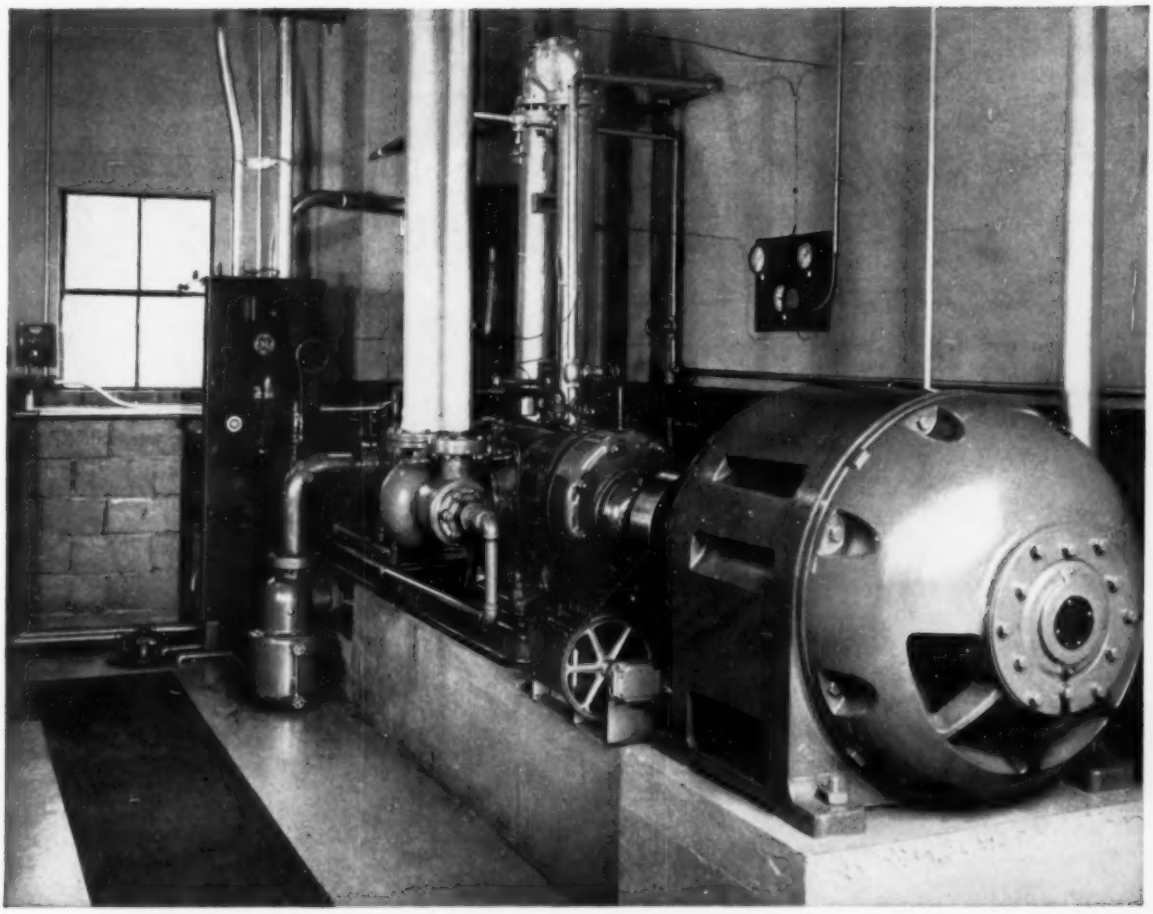
If it's an industrial fitting, whether for tubing or for hose, Parker has it or can make it, in standard sizes in any metal.

Parker "Triple-lok" for flared tubing . . . Parker "Ferulok"® for heavy-wall tubing . . . Parker "Weld-lok" for high-temperature, high pressure lines. ("Braze-lok", our newest line, does not require an open torch, is for medium temperatures.) "Intru-lok", for copper, aluminum or plastic instrumentation lines, requires no flaring. Parker hose and "Hoze-lok" re-usable hose fittings require no skiving of the hose.

There's a Parker distributor near you, write us for his name . . . call him for Parker catalogs.

Parker Fittings and Hose Division
17325 Euclid Avenue • Cleveland 12, Ohio

A DIVISION OF PARKER-HANNIFIN CORPORATION



Fuller Rotary Two-Stage Compressor, C135-135H. Capacity 680 c.f.m., 100-lb. pressure, 690 r.p.m., 150 hp. motor.

16,000 HOURS OF OPERATION WITH NO MAINTENANCE

Empire Steel Castings, Inc., Reading, Pennsylvania, installed a C-135-135H Fuller Rotary Two-stage Compressor in April 1953. After 32 months—approximately 16,000 hours of operation—the compressor received a routine inspection, when a new set of blades was installed in the higher-pressure cylinder.

The Empire engineers report no downtime since replacement, although they've added 4,000 operating hours. Prior to switching to Fuller, their former experience with compressors was a different story—as many as several overhaulings in one year. With Fuller equipment furnishing a constant high capacity air supply, production costs have been greatly reduced.

Here's how Empire uses compressed air:

- In the molding department, supplying all air for pneumatic rammers, all squeeze and jolt machines, automatic set-out and lifting apparatus of mold conveyors, automatic shake-out machines, mold cleaning and spraying equipment.
- In the core department, for ramming equipment, spraying and torch drying equipment, core oven operation as well as core blowing equipment.
- In the cleaning department, pneumatic chipping hammers and grinders, blacksmith requirements, sand-blasting, pressure testing and miscellaneous tools.
- In the heat-treating department, heat treating furnace operation and cooling equipment.

To get all the facts and engineering data, write today for Bulletin C-5A.

C-298
3682

FULLER COMPANY
GENERAL AMERICA

FULLER COMPANY
142 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Chicago · San Francisco · Los Angeles · Seattle · Kansas City · Birmingham

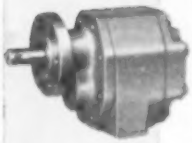
Fuller

PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

CIRCLE 53 ON TIME-SAVER CARD

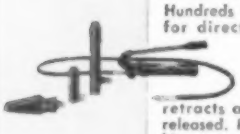
ENGINEERED HYDRAULIC ASSEMBLIES

for all industry...



Engineering to your specifications . . . and for your special problems or Standard hydraulic units as low cost "shelf items"

Large inventories always on hand in a variety of hydraulic motors, pumps, cylinders and control valves. Moderate in price due to long runs for stock. High production facilities for non-stock items . . . ample equipment reserved for short runs.



Pushmaster Remote Control Single Acting Industrial Jacks

Hundreds of uses in industry for direct push-power for moving, pressing, bending, straightening, lifting. Ram retracts automatically when released. Packed in carrying kits or stands with wide selection of accessory tools.

Push and Pull Remote Control Industrial Jacks

All the advantages of the single-action Jack plus direct push and pull power with one ram. 4, 10, 20 ton capacities. Carrying kits or stands.

HEIN-WERNER Industrial Jacks

Capacities: 1½, 3, 5, 8, 12, 20, 30, 50 and 100 tons. Eight ton jacks and up may be equipped with pressure gauges.

BE PREPARED!

Hein-Werner Industrial

RESCUE KITS

Small cost pays off thousands of times in an industrial accident. Tools clipped in-place for quick easy reach. Quick couplers on extensions save many minutes.

Hein-Werner CORPORATION
WAUKESHA, WISCONSIN

World's Largest Manufacturer of Hydraulic Jacks

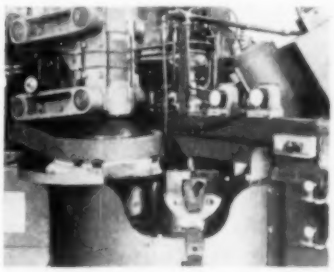
CIRCLE 66 ON TIME-SAVER CARD

BRIEFS

uses hydraulic motors to index the table and drive work-holding chucks. Four variable-volume vane pumps are used to provide hydraulic power. Two pumps are driven by each motor.

The entire machine cycle is automatically controlled from a console which has indicator lights giving a visual record of work status. Automatic sizing to compensate for wheel wear is also built-in the machine. Following each operation, pieces are automatically gaged and the gaging head signals the machine to feed as required.

The precision grinding head uses a hydraulic cylinder feed working against a lead screw stop.



Feed rates are adjustable for both rapid approach and fine feed strokes. Precision limit switches control and interlock all operations. ▼▼▼

Continued on page 38

BRIEF NOTES

NEW PLANT . . . Officials of leading Pacific-coast aviation and industrial firms met for the formal opening of the new Pacific Division of Titeflex, Inc. The 15,000 sq ft building contains manufacturing, assembly, engineering and warehouse facilities. It was established to improve service for the firm's West-coast customers.

NAME CHANGE . . . N. A. Pederson, President of C. B. Hunt & Son, Inc., Salem, Ohio, announced that the company has changed its name to Hunt Valve Co., to identify its name more closely with its products. Several new control valves will be introduced within the next few months.

NEW TRADE MARK . . . in the form of a bold W has been adopted by Worthington Corp. to replace their 73-year old winged trademark. Change was made to better identify company with trademark.

MOBILE COMPONENTS . . . New hydraulic components shown at recent SAE farm, construction, and industrial machinery meeting included: tube and shell oil coolers by Perfex; line of mobile hydraulic cylinders by Hannifin; a 4000-rpm, 13-gpm, 2500-psi variable-displacement piston pump by Lakeshore Div. of Bendix; a new stack valve by Webster. Technical sessions stressed need for clean oil to get desired service. Bright future for hydraulic drives is predicted.

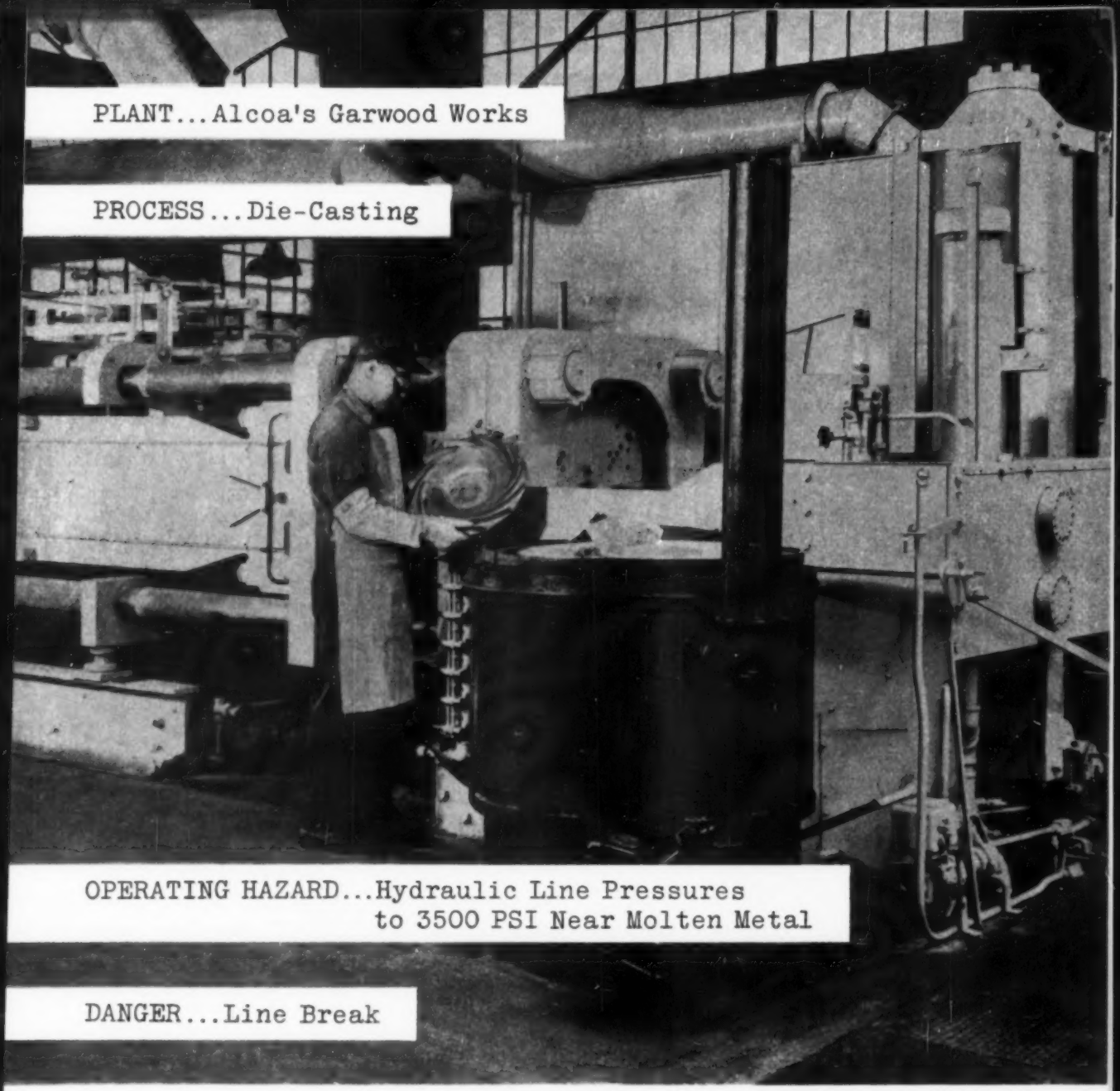
HYDRAULIC COURSE . . . In a recent News Letter published by Modernair Corp., there were kind words for the home study course in fluid power offered by Hitchcock Publishing Co., Wheaton, Ill. Two of Modernair's men are enrolled in the course and find its coverage is thorough, easily understood, and practical.

BUSINESS BRIEFS

EARNINGS UP . . . Parker-Hannifin Corp., Cleveland, Ohio, released their annual report for the fiscal year ending June 30. Net earnings for the year were $2,054,996 as compared with $1,622,526 for the preceding year. This year's earnings equaled $3.32 per share.

METAL GROUP BUYS HYDRAULIC FIRM . . . Metal Industries, Ltd., London, England bought out Towler Brothers, Ltd., well known hydraulic specialists in Europe. Frank Towler, internationally known authority on oil hydraulics, will continue as managing director of the firm.

CIRCLE 24 ⟶


PLANT...Alcoa's Garwood Works
PROCESS...Die-Casting
OPERATING HAZARD...Hydraulic Line Pressures to 3500 PSI Near Molten Metal
DANGER...Line Break

Hydraulic Fluid Used...FIRE-RESISTANT CELLULUBES

A 750-ton cold chamber die-casting machine at Alcoa's Garwood plant. Holding furnace in foreground contains molten metal, is close to pressurized hydraulic fluid lines.

In die-casting operations at its Garwood Works, Aluminum Company of America uses fire-resistant Cellulube hydraulic fluids to minimize the danger of fire in case of a break in hydraulic lines serving the die-casting machines.

Although there have occasionally been line breaks, under pressures ranging up to 2,000–3,500 psi, no serious fires have ever resulted. In addition, Alcoa has found that Cellulube fluids not only perform well as hydraulic media, but lubricate pump parts well.

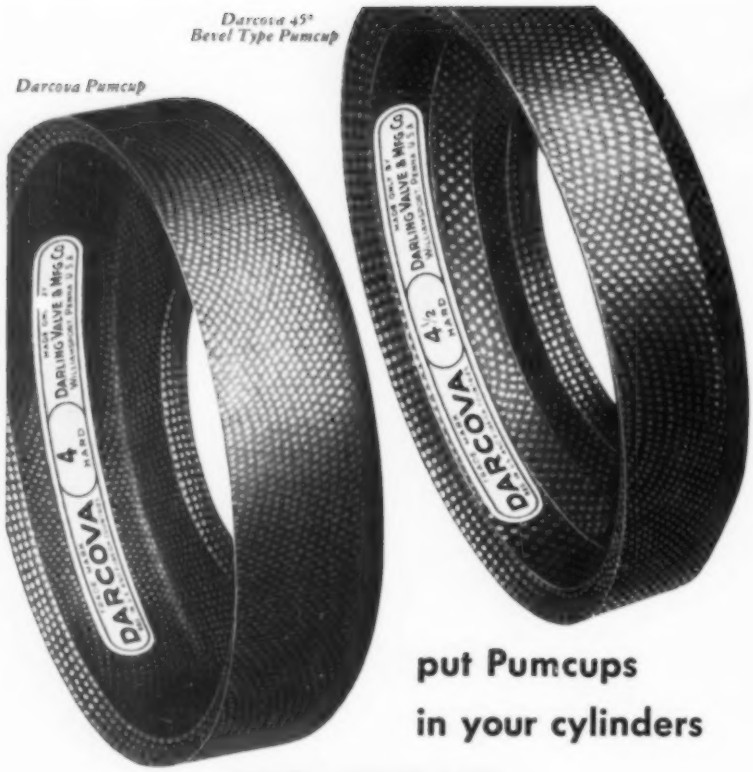
Cellulubes . . . the *safe* hydraulic fluids . . . are available in six controlled viscosities (90, 150, 220, 300, 550, and 1,000 S.U.S. at 100°F), one of which is best suited to your operations and the safety of your plant and personnel. If you'd like a sample for evaluation, please let us know the application involved.

Celanese Corporation of America, Chemical Division, Dept. 588-K, 180 Madison Avenue, New York 16, New York. Celanese® Cellulube®

Cellulubes... Celanese fire-resistant functional fluids

CHEMICALS

Canadian Affiliate, Canadian Chemical Co., Limited, Montreal, Toronto and Vancouver • Export Sales, Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N. Y.



put Pumcups
in your cylinders

TO HOLD PRESSURE LONGER!

In Darcova Pumcups a sound engineering principle has been combined with precision tolerances and extremely durable compositions to provide exceptional efficiency and life in hydraulic, air, and reciprocating pump cylinders of all kinds.

Unlike ordinary piston packing, precision Pumcups are engineered to minimize friction load while hugging cylinder walls on every pressure stroke. Regardless of eventual wear, efficiency *stays* high! So there's far less down-time and need for replacement.

Pumcups are made in a wide range of sizes, types and texture-engineered compositions, including 100% Nylon, for all kinds of pressure-temperature-fluid conditions. Send for Pumcup Bulletin 5503 and weigh all the facts!

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL CONTOUR CUP
TRADE MARK
PUMCUPS

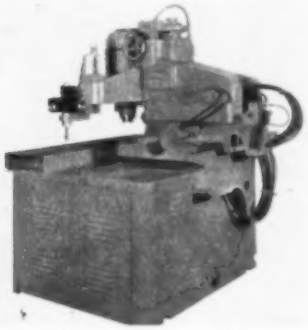
CIRCLE 35 ON TIME-SAVER CARD

BRIEFS

Fluid Power Assures Flexibility

• **Hydro Router**—This machine, developed by Turchan Follower Machine Co., Detroit, Mich., is equipped with a tracing control, stationary table to allow overhanging pieces, and completely enclosed power unit. The combination of tracer valve and the rigid adjusting assembly assures precision and flexibility.

• **Tracer Valve**—The new three dimension tracer valve is actually three individual high precision 4-way metering valves. Two are



mounted in a horizontal plane and one perpendicular. All three valves are manifolded to make a single valve operated by a stylus. The valve is designed to permit easy maintenance of any one of the three directional components. The tracing feed rate is infinitely variable.

• **Power Unit**—The hydraulic power unit has a two chamber reservoir capacity of 60 gal with provision for filtering and settling the oil. The unit has two pumps to assure enough volume when all three machine movements are operating together. This method of using a separate reservoir for each pump prevents starving one cylinder when tracing rapidly with another. The circuit has a separate supply of oil for the vertical movement of the ram and another supply for the combined horizontal movements of the saddle and ram. ▼▼▼

Continued on page 40

Canadian Affiliate: Canadian Chemical Co., Limited, Montreal, Toronto and Vancouver • Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 150 Madison Avenue, New York 16, N. Y.

RIVETT SQUAREMASTER "100" CYLINDERS

Unfailing POWER for MILLIONS of cycles!

Here's sure power for unfailing cylinder operation. SQUAREMASTER 100's are the world's finest constructed cylinders—perform with 100% efficiency! 200 P.S.I. air to 500 P.S.I. oil. Available in 7 mountings with standard dimensions, in 10 bore diameters, internal and external threading. Special models and cover combinations. Priced competitively; prompt delivery; meet all J.I.C. requirements.

RIVETT, INCORPORATED

Dept. AH-11, Brighton 35, Boston, Mass.

*Initial High Coefficient of Static Friction

POWER-PACKED FEATURES PROTECTED BY POWER-GUARD CONSTRUCTION

1. Piston rod. Ground and polished alloy steel. Hard chrome-plated. **2.** Piston rod bearing. Replaceable cartridge-type. **3.** Piston packing adjusts automatically. V-block packing minimizes friction. **4.** Correctly stressed tie rods. **5.** Cushion bushings. Bronze, floating type. **6.** Ports rotated to any 90° position. **7.** Steel covers. Take minimum mounting space.

Send for catalog. Proof of SQUAREMASTER efficiency stated in these 20 pages. Write today.

RIVETT furnishes a complete power package

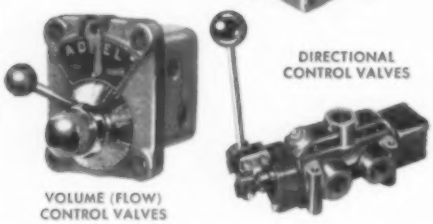
AIR AND HYDRAULIC — VALVES, CYLINDERS, POWER UNITS

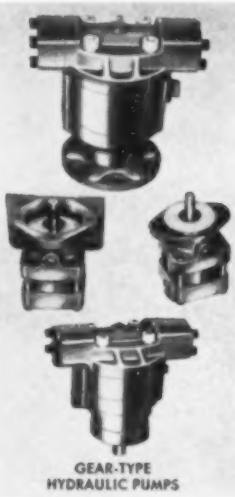
Member — National Fluid Power Association

CIRCLE 111 ON TIME-SAVER CARD

ADEL *Reliability in Your Hydraulic Systems*

BETTER MACHINE CONTROL...
FOR BETTER MACHINE PERFORMANCE





New Industrial Gear Type Hydraulic Pumps with capacities from ¼ to 35 GPM at pressures to 1500 PSI and speeds to 3600 RPM.

The diagrams show but two of innumerable circuits and systems where these versatile pumps and control valves can be used to advantage.

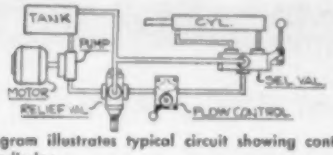


Diagram illustrates typical circuit showing control of cylinder.

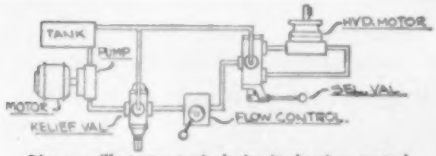


Diagram illustrates typical circuit showing control of hydraulic motor.

For metal working machines, industrial equipment, farm machinery, construction equipment, motor vehicles and marine applications... *Specify* ADEL *Precision-Engineered Hydraulics* for every mechanical operation in every industry.

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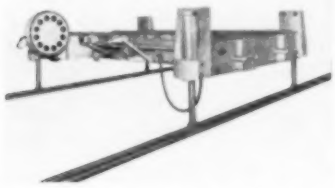
CIRCLE 3 ON TIME-SAVER CARD

BRIEFS

Drop Table For Servicing Diesel Locomotives

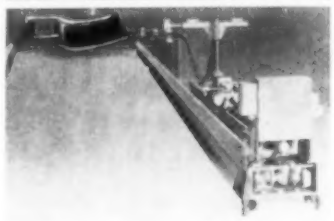
Four hydraulic cylinders raise and lower diesel locomotive trucks for servicing. Design is compact and requires only three feet between the drop table base and the locomotive track. This eliminates the need for expensive deep pits.

Geared flow dividers meter equal quantities of fluid to the four cylinders. Check valves at each

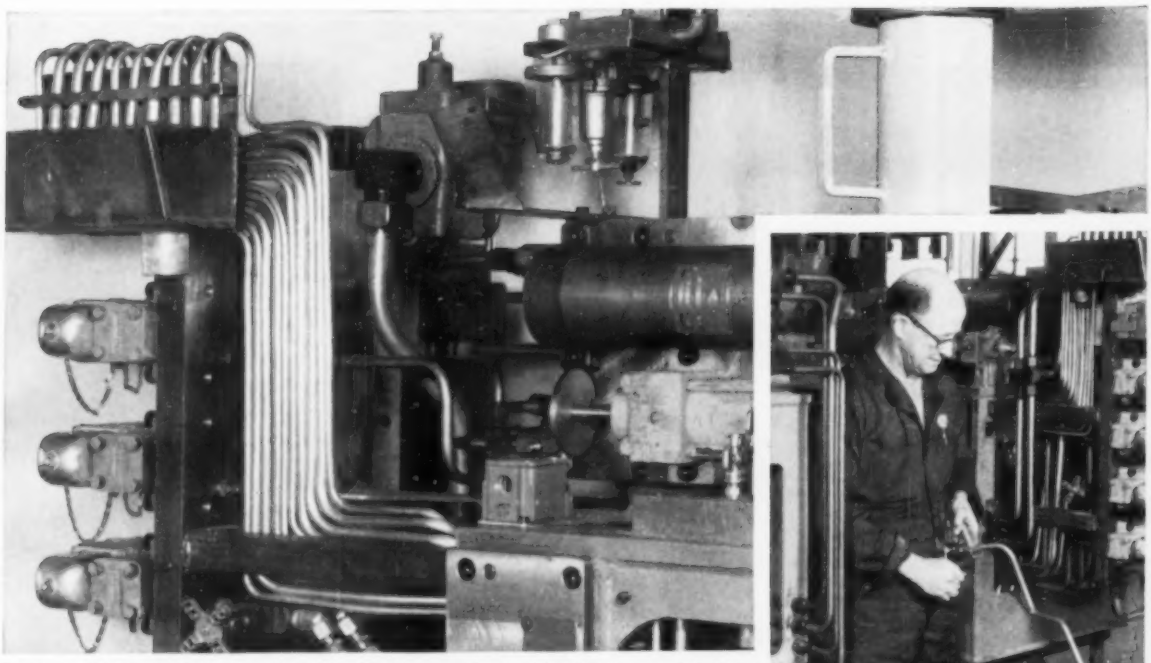


cylinder support the load if the pressure is interrupted. Controls are interlocked so that only one motion can occur at a time. Drop table is moved along the tracks by a hydraulic motor powered by an electric-motor-driven pump. Electric cable reel is spring-loaded. Motor, pump, reservoir and solenoid valves are enclosed in a dirt and moisture proof compartment. The unit made by Manning, Maxwell & Moore, Inc., Shaw-Box Crane & Hoist Div., Muskegon, Mich., will reduce man hours per job and locomotive down time. ▼▼▼

Continued on page 44



AIR-OPERATED press extractor uses one long-stroke cylinder to move the fingers into and away from the press and one short-stroke cylinder to operate the fingers. Operation is completely automatic. Unit is mounted on casters and can be moved from one press to another. Made by Die and Automation Inc., Hamilton, Ohio.



This Automatic Double Cavity Piston Moulding Machine, manufactured by The Permanent Mold Die Company, Detroit, Michigan, is one of 36 machines ordered by the Ford Motor Company. Cox Sales and Engineering designed and installed the fluid power lines using Republic ELECTRUNITE Hydraulic Line Tubing exclusively.

REPUBLIC ELECTRUNITE HYDRAULIC LINE TUBING

bends easier... flares with more uniformity ... saves money for the FORD MOTOR COMPANY

Here are economies you can measure! In designing and engineering, in manufacturing, in operating fluid power equipment, Republic ELECTRUNITE® Hydraulic Line Tubing saves *Time, Materials* and *Money.*

Made by Republic—world's leading specialty tube manufacturer—ELECTRUNITE is a truly uniform, highly ductile tube that provides excellent flaring and bending characteristics. And, because of this high quality and dependability, ELECTRUNITE is the accepted "resistance welded tubing" written into specifications by leading manufacturers. Here's why:

ELECTRUNITE is produced from highest quality flat-rolled open-hearth steel made in Republic's mills to Republic's rigid specifications. The ELECTRUNITE processing is a continuous weld method that unites the wall under pressure without the addition of foreign or extra metal. Both the inside and outside surfaces can be checked for defects. The overall uniformity of ELECTRUNITE assures fast, economical assembly. And every length of ELECTRUNITE is hydrostatically tested or FARROWTESTED® (Republic's exclusive nondestructive electrical test) to the customer's specifications.

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CIRCLE 110 ON TIME-SAVER CARD

New 3-Way Nylon-Body Solenoid Valve...

List Priced as Low as $10.75...

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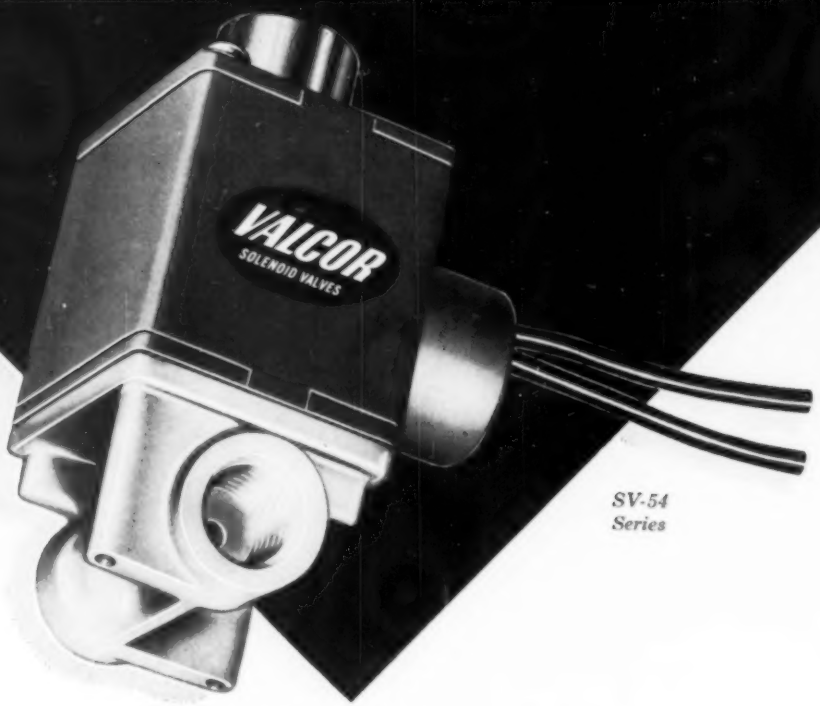
Outlasts, Outperforms Steel!



SV-54 Series

VALCOR'S new 3-way Nylon solenoid valve, SV-54 Series, outlasts and outperforms steel, yet is list priced as low as $10.75! In general purpose and O.E.M. installations, where millions of operating cycles are essential, this new Valcor valve not only works best but costs less.

Its nylon seat outlasts steel...its port threads outlast steel . . . pound for pound it's *3 times stronger than steel.* Dry seal threads, no compound is needed—and they won't loosen even under severe vibration. Nylon is non-corrosive so you have no atmospheric problems. And the stainless plunger is a reliable workhorse for millions of cycles. Bubble tight sealing. Available in normally open, normally closed and "directional control" configurations in all normal AC and DC voltages...1½" square x 3" long (valve illustrated).

Write today for complete technical data on this shock-resistant, pressure-proof valve—the 3-way nylon-body valve, SV-54 Series, that's 3 times stronger than steel, yet costs less. Try it on your toughest application.

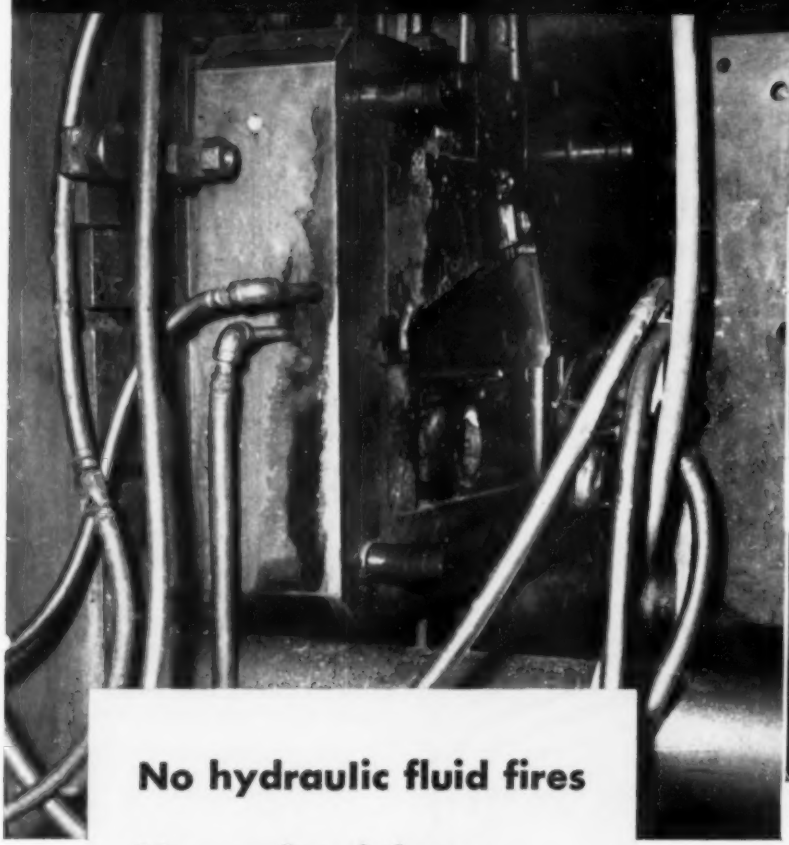
VALCOR SOLENOID VALVES

VALCOR ENGINEERING CORP.

5368 Carnegie Avenue, Kenilworth, New Jersey

CIRCLE 144 ON TIME-SAVER CARD

"For 3 solid years—



Irus Fluid's distinctive yellow color makes it easy to spot and trace leaks.

Complexity of lines (left) and pots of molten metals (above) represent the type of fire hazards requiring Shell Irus Fluid 902.

No hydraulic fluid fires

No worker injury

No equipment damage —since we switched over to SHELL IRUS FLUID 902"

says Ernie Ike, Plant Superintendent
Western Die Casting Co., Emeryville, Calif.

According to Mr. Ike, these results are directly due to the switch-over in 1955 from conventional hydraulic fluids to Shell Irus Fluid 902.

Irus® Fluid 902 is a special combination of petroleum oils mixed with water and emulsifying agents. Its fire resistance is achieved through the relatively high water content. Irus snuffs out fire, *under plant conditions.*

Another important advantage of Irus Fluid 902 is its low cost. Plant operators now using Irus have discovered that Irus Fluid costs up to one-third less than other fire-resistant fluids . . . yet is comparable in performance in every practical respect.

If the hydraulic equipment in your plant is exposed to fire hazards, let a Shell Industrial Representative show you the advantages of Irus Fluid 902. Write Shell Oil Company, 50 West 50th St., New York 20, N. Y. or 100 Bush St., San Francisco 6, Calif.

SHELL IRUS FLUID 902

a low-cost, fire-resistant hydraulic fluid

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HIGH-PRESSURE Ball Valves

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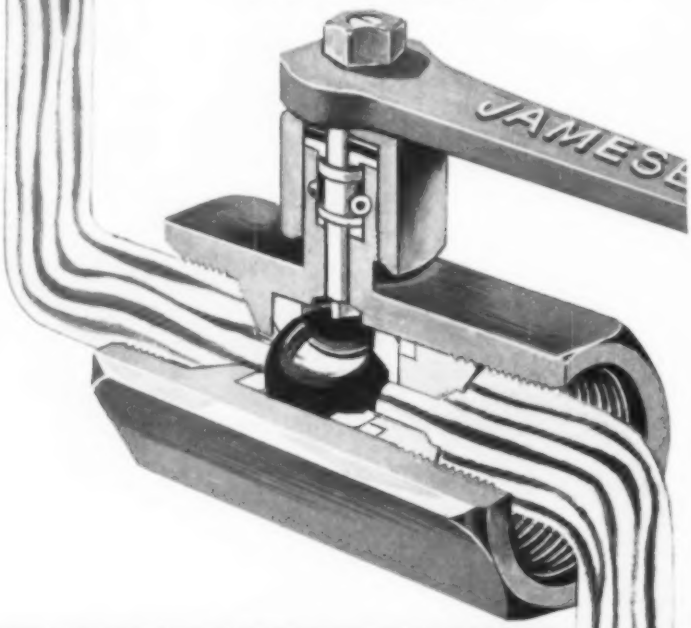

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—a newly developed and advanced valve design with broad industrial applications, available in eight sizes through 2", with 303 and 316 Stainless Steel or Carbon Steel bodies. Choice of nylon or "Teflon" seats and seals.

Distributors in principal cities.

For further information, write: Data: Style "H" Series

925-B

JAMESBURY CORP., 85 NEW STREET, WORCESTER, MASS.

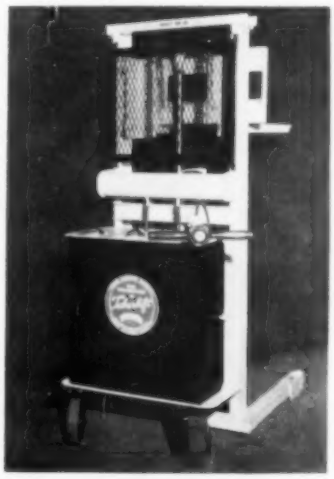
CIRCLE 76 ON TIME-SAVER CARD

BRIEFS

Hydraulic Wheel Propels Platform Lift

In order to reduce the muscle power required to move a platform lift, Mechanisms, Inc., Uhrichsville, Ohio, designed a hydraulically operated wheel which is being used on lifts made by Uhrden, Inc., Dennison, Ohio.

CUT AWAY VIEW of hydraulic wheel shows the vanes held to the cam by springs. Holes in axle allow oil to pass to and from the wheel. Ports in retainer ring hydraulically balance wheel.

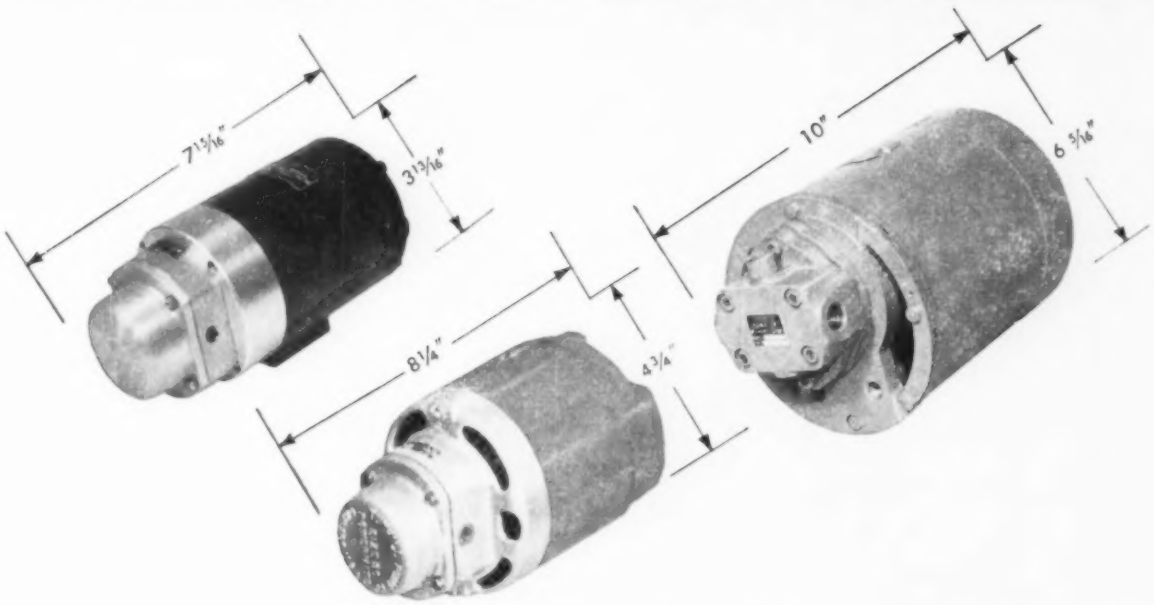


PLATFORM LIFT is driven by a hydraulic wheel. This unit uses one 4-way valve to operate the wheel and one 3-way valve for the lift cylinder.

Construction of the wheel is similar to a vane type motor with the vanes contained in a ring and held against a cam by springs. Since operating speed is only 100 rpm, centrifugal force does not throw the vanes out. Two inlet

Continued on page 46

Cut Product Costs with **POWERMITE**



custom engineered pump and motor combinations

More and more manufacturers are learning the economy of incorporating Tuthill's exclusive Powermite Pump and Motor Combinations in their products. These custom engineered units incorporate a specially designed electric motor into a rotary gear pump . . . to produce a combination unit which takes up no more space and weighs no more, than a conventional electric motor.

The Powermite's compactness solves tough design problems. Its small size and low weight make it easier to install . . . boost production line productivity. The elimination of bases, couplings and other parts result in substantial economies. Its lower weight reduces shipping costs. And all Powermites provide the long trouble-free life which industry has learned to expect from Tuthill.

Wide range of combinations

A wide range of pump and motor combinations can be provided to meet individual requirements in hydraulics, lubrication, circulating, coolant, and other pump services. Three typical examples are shown above.

The compact unit to the left, developed for use on a small mobile hoist, combines an internal gear pump rated for 30 cu. in./min. at 500 psi, with a $\frac{1}{8}$ hp motor. The center unit, developed for a low pressure hydraulic application combines an internal gear pump with a capacity of 16 gph at 250 psi with a $\frac{1}{12}$ hp motor. The unit at right combines a high pressure hydraulic spur gear pump, for rated conditions of 1 gpm at 1,000 psi with a $\frac{3}{4}$ hp motor.

Custom engineered for your application

Each Powermite model is custom engineered for a specific OEM application and is designed to permit substantial economies for high volume production. A few Powermite models are available from stock—for example, the 350 psi, 16 gph model shown at center above. For small quantity applications Tuthill Close Coupled Pump and Motor Combinations can provide similar savings.

Manufacturers interested in learning more about the advantages of incorporating Powermite combinations into their products are invited to forward detailed specifications. Or, if preferred, a Tuthill Field Engineer will call.

TUTHILL PUMP COMPANY
981 East 95th Street
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Gentlemen:

☐ Please have representative call to discuss Powermite applications in my product.

☐ Please send catalog describing complete Tuthill line.

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Tuthill Manufactures a Complete Line of Positive Displacement Rotary Pumps in Capacities From 1 to 200 GPM; for Pressures to 1500 PSI; speeds to 3600 RPM.

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY

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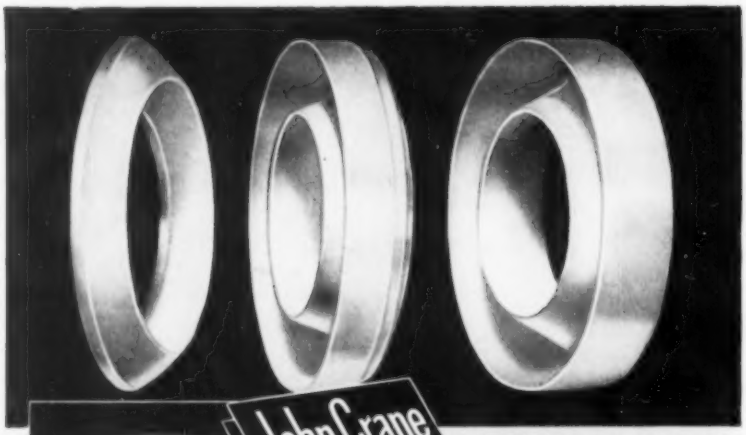
CIRCLE 129 ON TIME-SAVER CARD

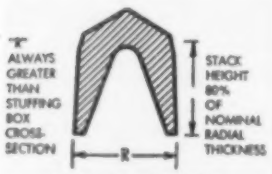


John Crane CHEMLON* C-V RINGS ARE INDUSTRY'S MOST UNIVERSAL PACKING . . .

Countless successful applications of C-V Rings under the most severe service conditions have made this the closest approach to a universal packing.

It will effectively handle all industrial acids, alkalis, solvents, organic and hydraulic fluids . . . temperatures from −120°F. to +500°F. . . . is equally suited to valves, pumps, mixers, hydraulic cylinders and like equipment.

"John Crane" C-V Rings have extremely low coefficient of friction. "Breakout" friction is only slightly higher than running friction.



C-VU RING CONSTRUCTION

C-VH RING CONSTRUCTION

TWO STYLES ARE AVAILABLE:

C-VU RINGS *for low pressure service* —such as control and regulator valves handling gases and fluids, where it is necessary to have a very sensitive and resilient type packing.

C-VH RINGS *for high pressure service* —for use in pumps, hydraulic cylinders and like services at pressures ranging to 500 psi. and over. These rings are constructed with a heavy wall heel to withstand pressure requirements. They are designed to provide voids between rings, so that as the Teflon expands due to heat, this take-up room minimizes any excess friction in the stuffing box.

"John Crane" C-V Rings are available in full line of standard sizes and male and female adaptors. Sizes can be molded to stuffing box specifications.

Request Bulletin P-325

*"John Crane" C-V Rings are made from Chemlon—*the best in DuPont Teflon.*

Crane Packing Co., 6405 Oakton St., Morton Grove, Ill. (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

CRANE PACKING COMPANY

CIRCLE 33 ON TIME-SAVER CARD

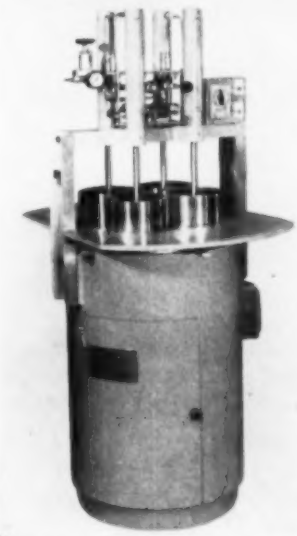
BRIEFS

and outlet ports in the periphery of the cam keep it in balance.

Oil passes to and from the wheel through two ports in the stationary axle. Drilled holes in the mounting elbow carry oil down from the mounting block.

At 1.7 gpm and 1000 psi the speed of the platform lift is 2 mph. With a 1200 psi relief valve setting the maximum thrust is all one man can pull. This safety feature protects the battery and motor and limits the size of obstruction over which the wheel will climb, preventing upsets.

The wheel can be turned 360 degrees for manipulating in narrow aisles. ▼▼▼

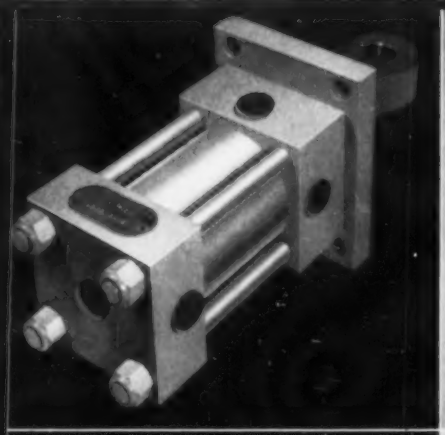


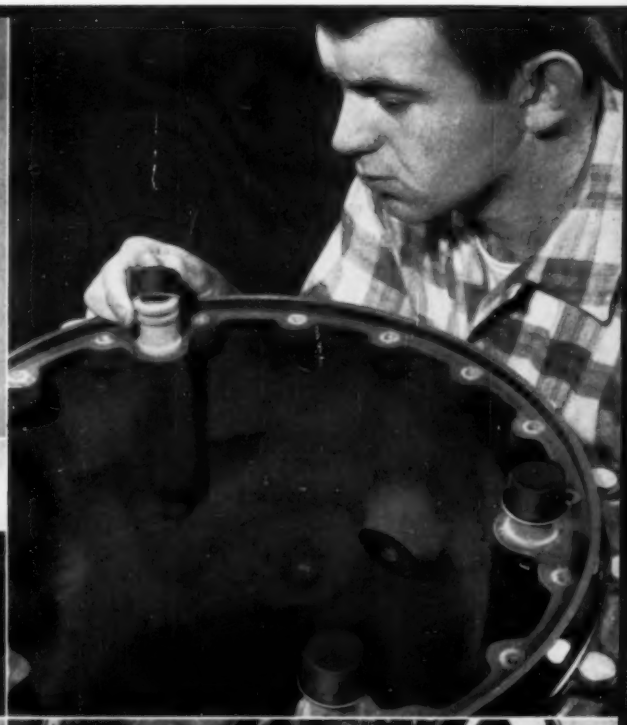
FOUR DOUBLE-ACTING air cylinders controlled by a timer and 2-position, 4-way valves operate this lapping machine. Machine can be used with carbides, ceramics, hardened steel and aluminum. Tolerances of ± .0005 in. can be held and production rates of 125 pieces per hr are not unusual. Made by Abrading Systems Co., Skokie, Ill.

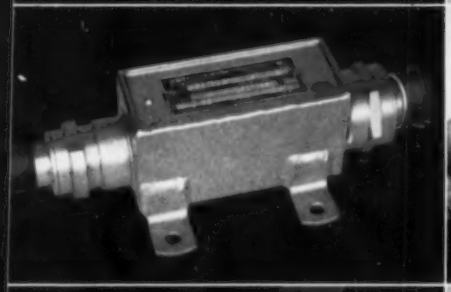
Hydraulic Presses Are Fast Acting

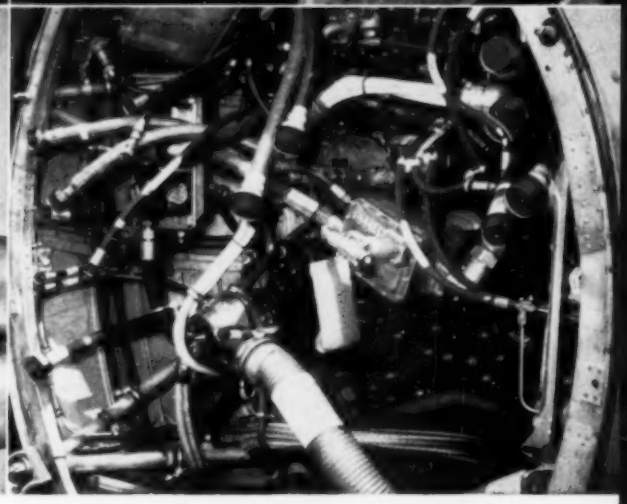
A complete line of C-Frame presses in 5, 10, and 15-ton capacities are being made by Hydraulic Press Mfg. Co., a Division of Koehring Co., Mount Gilead,

CIRCLE 107 ⟶









chances are you'll find Caplugs ideal for your closure needs, too . . . they're made of tough, flexible Polyethylene . . . easy to apply and a cinch to remove . . . won't chip, break, shred or collapse . . . over 500 sizes in a dozen different styles now on the shelf.

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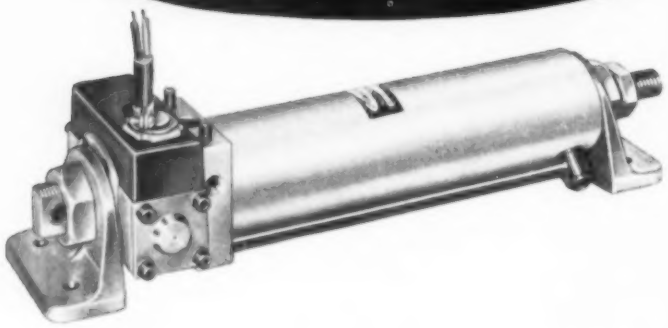
VIH (VALVE-IN-HEAD) CYLINDERS



Here's a combination that's hard to beat — a performance-proved industrial air cylinder with its own built-in directional and exhaust speed control valves — in a single, compact "package". Check these important features:

- **BUILT-IN DIRECTIONAL CONTROL VALVES...** your choice of four control combination; double solenoid, single solenoid with button bleeder return, double button bleeder, or double remote pilot pressure operation.
- **BUILT-IN EXHAUST SPEED CONTROLS** with automatic Nylon lock.
- **INTERCHANGEABLE MOUNTINGS...** front or rear flange, low or high "L" foot brackets, rod and cylinder clevis.
- **SINGLE CONDUIT CONNECTION** for double solenoid unit.
- **AVAILABLE WITH CUSHIONED STOP** either or both ends.
- **PERFORMANCE-PROVED MODERNAIR CONSTRUCTION**

Condensed Specifications

DIAMETERS: 1½", 2", 3"
ROD SIZES: ½", ⅝", ¾"
MIN. OPERATING PRESSURE: 20 p.s.i.
SOLENOID POWER REQUIRED: 10 watts
MAX. OPERATING PRESSURE: 150 p.s.i. (solenoid) 200 p.s.i. (bleeder or pilot pressure)
SOLENOID COILS AVAILABLE: (ac) 8-10, 110, 220 v. (dc) 12, 24, 30 v.

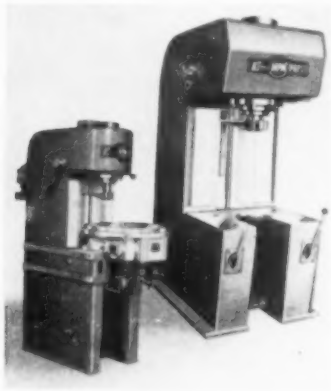
Call your local MODERNAIR sales outlet (see Modernair trademark under "CYLINDERS" in the yellow section of your phone book) or write us today for complete data bulletin; please address Dept. B-11.

Modernair Trademark **CORPORATION**
400 Preda Street · San Leandro, California
MEMBER NATIONAL FLUID POWER ASSOCIATION

CIRCLE 91 ON TIME-SAVER CARD

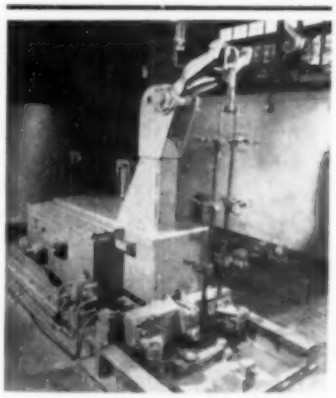
BRIEFS

Ohio. All models meet JIC specifications. Manual presses have dual lever safety control, and servo-controlled action, which lets the operator apply ram force at speeds



and pressures directly proportional to the movement of a hand lever. A positive ram guide assures accurate positioning so that alignment of tooling is held to close tolerance.

Presses are also made with an automatic index table having a hydraulic interlock. They can have up to 12 tooling stations and be operated at speeds to 80 indexes per min. The table is designed so that ejection cylinders or other tooling may be mounted to the housing beneath the table. ▼▼▼



LOADING-UNLOADING of conveyors can be done with this automatic machine. The unit will lift a part from one conveyor and place it on another. It is all hydraulically operated and can be adjusted for any stroke length desired. It can be made to pick up two or four racks or baskets at the same time. Built by Wagner Brothers Inc., Detroit, Mich.

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whatever hydraulic problem has you stumped. A trained Denison Hydraulic Specialist is ready to sit down with you and analyze your problem.

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the most efficient hydraulic circuit to handle your specific needs. We can do this while you wait.

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- **NEWARK** 315 Central Avenue Clark, New Jersey
- **COLUMBUS** 1160 Dublin Road Columbus 16, Ohio

CIRCLE 36 ON TIME-SAVER CARD

For hydraulic systems that must stay on the job . . .

Specify Flexon Hose

in rubber, synthetic or metal

FLEXON RUBBER AND SYNTHETIC HOSE AND COUPLINGS

Flexon Bulk Hose is offered in a complete range of types and sizes up to 2" for automotive, aircraft and industrial services.

Flexon Hose Assemblies are furnished with the broadest choice of standard and special fittings for low, medium and high pressures.

Flexon Reusable Couplings save time and money. All are equipped with Easy Grip Hex on stem for safe, speedy insertion into hose without the use of special mandrels.

Flexon Crimped-on Couplings are factory attached to provide complete hose assemblies to your specifications.

Flexon Dynalock Couplings are the ultimate in a clamp type reusable coupling.

Flexon Adaptors, Unions & Connectors are available in a complete range of sizes and types for all services.

FLEXON METAL HOSE AND COUPLINGS

Flexon Corrugated Hose is the standard of the industry. Available in a variety of types in stainless steel, steel, bronze and other alloys.

Flexon Metal Hose Assemblies combine industry proven hose and couplings into a wide range of standard and special units.

Flexon Moisture Resistant Conduit combines a synthetic cover with a metal liner to form flexible electrical conduit.

Flexon Metal Hose Couplings are made in a complete range of sizes and styles for all types of Flexon Metal Hose.

Write for Bulletin C-100, covering rubber hose, and Bulletin 170, covering metal hose; no obligation.

• Flexonics Corporation is your Engineering Center for hose connections. As manufacturers of the broadest range of hose connectors and with over 56 years manufacturing experience, Flexonics is particularly well qualified to help you in your application problems. Whenever you have a problem that may be solved by the use of hose, let Flexonics Application Engineers assist you. Just send an outline of your requirements.

Flexonics *Corporation*

HOSE DIVISION
G-42

Mr. Flexon identifies products of Flexonics Corporation that have served industry for over 56 years.

1385 S. Third Avenue • Maywood, Illinois

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Manufacturers of metal and rubber hose, expansion joints, metallic bellows and aircraft components.

CIRCLE 48 ON TIME-SAVER CARD

FUTURE EVENTS

November 3-5: National Fluid Power Association fall meeting, Drake Hotel, Chicago, Ill. For information write Barret Rogers, Executive Secretary, 1618 Orrington, Evanston, Ill.

November 19: ASME Hydraulic Section Meeting. J. R. Hemeon on "Engineering for Life of Hydraulic Systems." Consolidated Edison Building, 4 Irving Place, New York, N. Y.

November 30-December 5: American Society of Mechanical Engineers Annual Meeting. Statler and Sheraton-McAlpin Hotels, New York, N. Y.

December 4-5: Industrial Engineering Conference, Illinois Institute of Technology, Chicago, Ill.

January 12-16, 1959: SAE Annual Meeting, and Engineering Display. Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

January 26-29: Tenth Annual Plant Maintenance and Engineering Show. Public Auditorium, Cleveland, Ohio.

February 2-6: Material Handling Exposition and Conference. Automotive Building, Toronto, Canada.

March 19-20: SAE National Production Meeting. The Sheraton-Cadillac Hotel, Detroit, Mich.

March 31-April 3: SAE National Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display. Hotel Commodore, New York, N. Y.

April 14-15: Tenth annual Earthmoving Industry Conference. Peoria, Ill. Sponsored by central Illinois Section, SAE.

April 20-24: SAE A-6 Aircraft Hydraulic and Pneumatic Meetings, Cleveland, Ohio.

▼▼▼

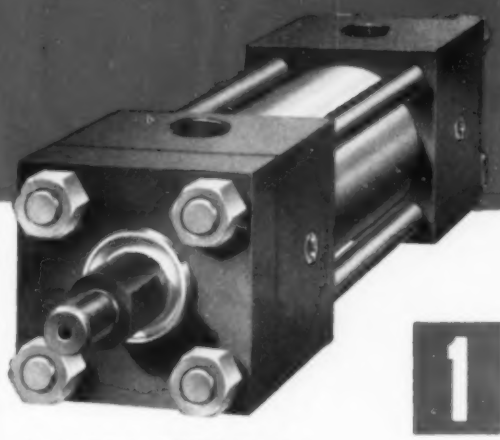
CIRCLE 88 ⟶

SEAL FAILURE MEANS CYLINDER FAILURE

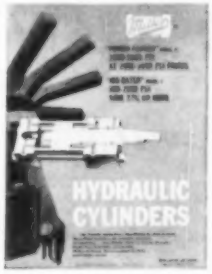
Petroleum base, fire-resistant and special hydraulic fluids cause distortion and rapid deterioration of the seals currently used in many hydraulic cylinders, resulting in costly repairs and cylinder failure. (Seals made of synthetic rubber are not compatible with even 50% of available commercial petroleum base fluids and the life of such seals is materially reduced at operating temperatures above 150° F.)

Specify Miller HYDRAULIC CYLINDERS

FOR UNLIMITED SEAL LIFE!



Request Bulletin JH-104N for complete data plus helpful charts on column strength, cylinder forces, factors of safety, acceleration, pipe pressure losses, etc.



1 ALL TEFLON* SEALED Against External Leakage

TEFLON is impervious to all known hydraulic fluids, including all fire-resistant and special types – and withstands temperatures from −100°F. to plus 450°F.

TEFLON SHEF SEAL AT TUBING ENDS

No blind assembly. Is
Shear-proof
Heat-proof
Extrusion-proof
Fluid-proof

TEFLON SEALS ON PISTON ROD AND BUSHING

Teflon rod flange seal requires no adjustment. Teflon bushing seal is shearproof. Teflon wiper keeps dirt out.

TEFLON SEALS ON BALL CHECK AND ADJUSTING SCREW

Non-protruding, self-locking, cushion adjusting screw interchangeable with ball check for easy access.

2 CASE-HARDENED CHROME PLATED PISTON RODS

Provide foolproof protection against seal failures resulting from rod damage. The Miller case-hardened rods (50-54 Rockwell C) give practically complete immunity to damage from hammer blows, wrench-dropping, mishandling, etc. The hard chrome plating over the case-hardened rods protects against scratch-damage and rust.

AVAILABLE IN TWO TOP QUALITY LINES

JOB-RATED
Model "J"

PRICE SAVINGS OF 27% OR MORE!

19 mounting styles, all strokes, cushioned and non-cushioned. Large selection for immediate shipment.

BORE	SEVERE OPERATING CONDITIONS	MODERATE OPERATING CONDITIONS	YOU SAVE THIS % IN PRICE OVER STANDARD 2000-3000 PSI CYLINDERS
1½"	1500 PSI	2500 PSI	27%
2	1500	2500	27%
2½	1000	1500	28%
3¼	1500	2500	32%
4	1000	1500	35%
5	800	1200	37%
6	800	1200	43%
8	500	800	50%
10	500	800	71%
12	500	800	76%
14	500	800	*Not Available in 2000-3000 PSI*

POWER-PACKED
Model "H"

50% More Power Per Cylinder Dollar!

For
3,000-5,000 P.S.I.

1½" through 12" bores, 17 mounting styles, strokes up to 22 ft., cushioned and non-cushioned. Large selection for immediate delivery.

*DuPont trademark for its tetrafluoroethyline resin

S SHEAR PROOF
H HEAT PROOF
E EXTRUSION PROOF
F FLUID PROOF
SEAL
Teflon Pressure Energized
Hydraulic Cylinder Tubing End Seal
PAT. APPLIED FOR

OTHER MILLER QUALITY FEATURES

- Solid Steel Heads, Caps and Mountings.
- Precision-Honed Barrels.
- Rust-Resistant Coating on All Non-Wearing Surfaces.
- Space-Saving "Square" Design.

MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION

2008 N. Hawthorne Ave., Melrose Park, Illinois

AIR AND HYDRAULIC CYLINDERS · ACCUMULATORS
COUNTERBALANCE CYLINDERS · BOOSTERS

Tubexperience in action

Brightness alone is not the true measure of hydraulic tubing quality!

*Bright ID and OD surfaces are important in hydraulic tubing. But mere brightness is not enough! Superior SAE Hydraulic Tubing delivers unsurpassed brightness; plus these other vitally important advantages—

High ductility! Furnished in dead-soft annealed temper, Superior hydraulic tubing flares easily, bends without pinching, is readily fabricated for any hydraulic application.

Non-aging steel! All Superior carbon hydraulic tubing is made of selected non-aging steel. It keeps its ductility. Will not become brittle with age. Carbon content is limited to .12% maximum.

Fully tested! And not mere random sample testing! Every length of Superior SAE Hydraulic Tubing is 100% hydrostatically tested at maximum working pressure—giving you realistic performance insurance.

Rust preventive coating! All Superior SAE Hydraulic Tubing is shipped to you specially coated with a rust preventive on both inside and outside surfaces. Not just a coating of oil!

Special processing gives Superior hydraulic tubing an unusually bright, lustrous, smooth, clean ID and OD finish. No premium costs to pay for bright, bright surfaces with Superior tubing!

Available coast to coast through leading warehouse distributors, each a steel service center. Contact your nearest Superior distributor—or, for more information, send for a free copy of Bulletin 39. Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010 in. to ⅝ in. OD—certain analyses in light walls up to 2½ in. OD

West Coast: Pacific Tube Company, 5710 Smithway St., Los Angeles 22, Calif. • RAymond 3-1331

CIRCLE 122 ON TIME-SAVER CARD

Houghton 1243 rubber-impregnated leather

The answer to five packing problems

• Positive seal at zero pressure • Rubber's resilience, without rubber's friction • Wear far surpassing either homogeneous or fabricated rubber • Resistance to high pressures and abrasion • Compatibility with fire-resistant hydraulic fluids and/or mineral oils

applications engineering service

Because Houghton makes both packings and fluids, they maintain a continuing packing-test program offering customer service on packings of all materials, fluids, which it also manufactures, and hydraulic and pneumatic packing applications engineering. As a result, Houghton has become "packing headquarters" for many of the leading manufacturers of hydraulic and pneumatic equipment.

An exclusive Houghton process puts pure polysulphide rubber between the leather fibers of #1243 packings. Penetration is complete.

Porosity often found in leather packings is eliminated. The packing is flexible, easy to install. There is none of the stiffness of wax-impregnation.

Wear resistance is increased by Houghton's process of molding packings with the flesh side of the leather exposed to wear, rather than the smooth, hair side. In tests, #1243 cup packings have run more than twice as long as the total service life of conventional packings, without losing the smallest fraction of their sealing efficiency.

This unique, durable material is available in pre-formed cup packings, "V" packings (which may be used in combination with Houghton rubber and fabricated rubber "V's") and "U" packings.

Write today for the latest #1243 bulletin and engineering information. E. F. Houghton & Co., 303 West Lehigh Ave., Philadelphia 33, Pa.

PACKINGS

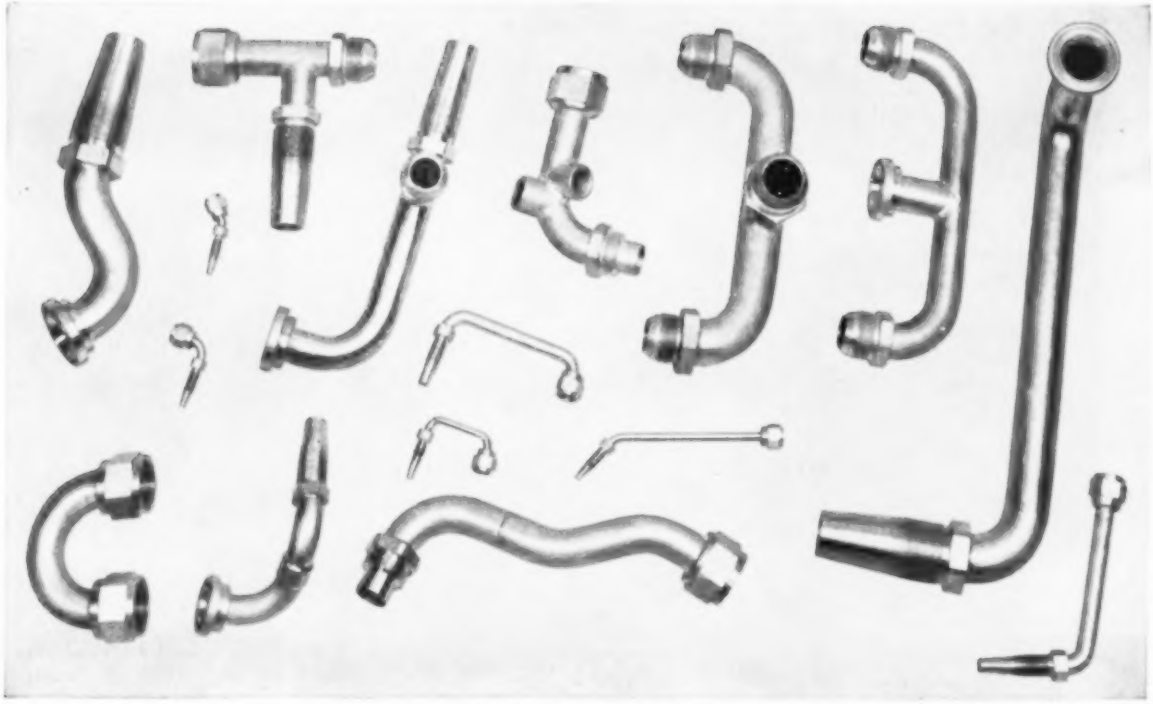
. . . products of

E. F. HOUGHTON & CO.

PHILADELPHIA • CHICAGO • DETROIT • SAN FRANCISCO

Ready to give you on-the-job service . . .

CIRCLE 69 ON TIME-SAVER CARD



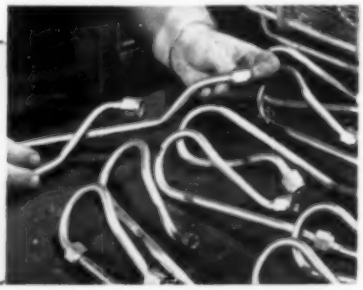
Solve Fluid System Design Problems with Aeroquip Precision Tubing . . . Formed to Your Specifications

Fluid systems requiring special formed tubing can be designed with Aeroquip precision tubing fabricated to your exact specifications. With over 10 years' experience producing high quality aircraft tubing, Aeroquip has the engineering skill and test equipment to make sound design recommendations for all types of industrial fluid systems. Extensive manufacturing facilities assure volume production of any tubing configuration, in a wide range of materials, sizes and fitting connections.

Submit your fluid line problem to our sales engineering department and mail the coupon below for our precision tube forming Catalog No. 500.

ABOVE—Fittings for this steel tube configuration are being arc welded with an inert gas shield to produce a sound, more uniform weld. Five different welding or brazing processes for tubing are available at Aeroquip.

BELOW—Volume production of this 5-bend tubing configuration was made possible by the development of unique tube-forming equipment by Aeroquip engineers.



Aeroquip

REG. TRADEMARK

AEROQUIP CORPORATION, JACKSON, MICHIGAN

INDUSTRIAL DIVISION, VAN WERT, OHIO • WESTERN DIVISION, BURBANK, CALIFORNIA
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INFORMATIVE CATALOG AVAILABLE

AEROQUIP CORPORATION, JACKSON, MICHIGAN

Please send me a copy of Catalog No. 500 on Aeroquip Precision Tube Forming facilities

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COMPANY_____

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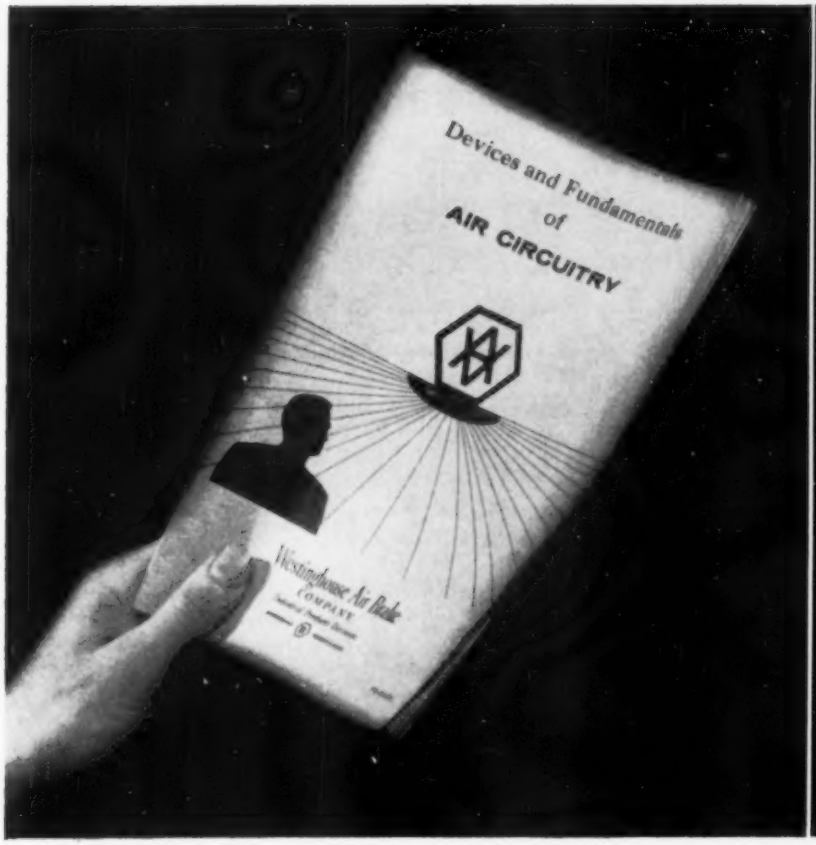
CITY_____ ZONE_____ STATE_____ AH-11

CIRCLE 4 ON TIME-SAVER CARD

NOW AVAILABLE . . . Another helpful booklet on a new concept for air control



* If you do not have a copy of our earlier booklet, "Basic Pneumatic Control," check the space indicated in the coupon and we will be glad to send you a free copy along with the new booklet.

A comprehensive discussion of the 4 basic principles involved in designing an economical "control by air" system for industrial machines and processes.

Westinghouse Air Circuitry means the *control by air* rather than the mere use of it. It deals with the interlocking, sequencing, timing and segregation of events to obtain automatic or semi-automatic control. It is applicable to any automation problem on any industrial machine . . . in any industrial process. The equipment involves uncomplicated mechanical devices with few moving parts.

Any mechanic can easily install and service a Westinghouse Air Circuitry system.

Send for your FREE copy

Fill in and mail the coupon for a copy of this interesting booklet today.

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Westinghouse Air Brake Company
Industrial Products Division, Dept. AH-1381
Wilmerding, Pennsylvania

Please send me free copies of the following booklets on Westinghouse Air Circuitry:

☐ Devices and Fundamentals of Air Circuitry
☐ Basic Pneumatic Control

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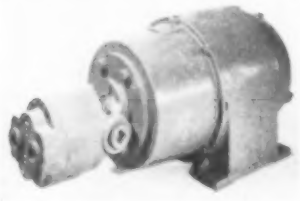
ADDRESS .....
CITY ..... STATE .....

CIRCLE 142 ON TIME-SAVER CARD

NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

HYDRAULIC GEAR PUMP . . . 44 gpm at 500 psi



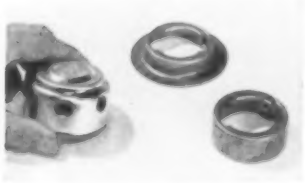
Features: For industrial and mobile use where high volume is required. Made with electric motor or gasoline engine drive.

Specifications: Capacities to 44 gpm at pressures to 500 psi and speeds of 1140 rpm. Rotary gear-type pumps with heat treated alloy steel gears and shafts, antifriction bearings and self-balancing mechanical seals.

Brown & Sharpe Mfg. Co.
Hydraulics Div.
Providence, R. I.

CIRCLE 300 ON TIME-SAVER CARD

FILLER CAP . . . serves as breather-filter



Designation: Model 1990-A

Features: Protects against contamination that can damage pumps and valves. A ribbon-type element rated at 40 microns is held in a cadmium-plated steel case. Is cleanable and can be used indefinitely.

Specifications: Two types of filler hole fittings are made to hold the filler cap. One for flange mounting on the reservoir and the other mounts on the end of a filler tube. Threaded models are also available from ¼ to ¾-in. NPT.

Bendix Filter Div.
Bendix Aviation Corp.
Madison Heights, Mich.

CIRCLE 301 ON TIME-SAVER CARD

HYDRAULIC CHECK . . . controls air cylinder speed

Designation: Model 1500

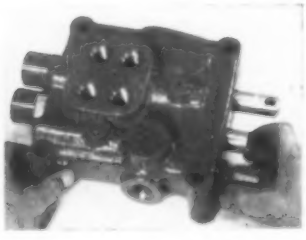
Operation: Will check thrust loads to 1500 lbs. on either *in* or *out* stroke and allow free movement of opposite stroke. Gives uniform feed and prevents chatter. Any portion of stroke can be controlled by positioning the adjusting nuts on the rod.

Specifications: Made in six sizes with strokes to 12 in. Overall lengths to 26½ in. Cylinder bore 1.385 in. and ½ in. rod diameter. O-ring piston and head seals. Meets AN and JIC specifications.

Appco Corp.
Olmsted Falls, Ohio

CIRCLE 302 ON TIME-SAVER CARD

DIRECTIONAL VALVES . . . for 2000 psi



Features: Rugged construction for earth moving, material handling, agriculture, and industrial equipment. Open-center parallel-circuit design allows independent or simultaneous operation of cylinders or hydraulic motors. Good metering characteristics. Made with single or double-acting hardened spools.

Specifications: Pressures to 2000 psi. Flows 5 to 25 gpm. Valve bodies can have up to 6 spools. Ports are SAE O-ring straight thread. Built-in relief valve and a separate check valve for each spool.

Wooster Div.
Borg-Warner Corp.
Bedford, Ohio

CIRCLE 303 ON TIME-SAVER CARD

Continued on page 58

MARVEL Synclinal FILTERS

SUMP TYPE
(Cutaway)

For Efficient Filtration of–

Hydraulic Oils

Fire Resistant Hydraulic Fluids

Coolants–Lubricants

Water

OVER 800
Original Equipment Manufacturers Install Marvel Synclinal Filters as Standard Equipment

LINE TYPE
(Cutaway)

PROTECT EQUIPMENT
INCREASE PRODUCTION
REDUCE MAINTENANCE

Marvel Synclinal Filters installed in the sump or on the line preceding pump offer maximum protection on all hydraulically actuated and other equipment utilizing low pressure circulating oil systems. Maintenance and production costs are reduced because Marvel Synclinal Filters BALANCED design offers greater ACTIVE filtering area with sufficient storage capacity for filtered out damaging particles, thus, longer periods of productive operation are attained at minimum "down-time" due to maintenance and repairs.

IN-LINE FILTER

Handles up to 25 G.P.M. of hydraulic oil at very low pressure drop. Monel wire cloth filtering media in mesh sizes from 30 to 100. Cartridge is easily removed for cleaning.

PRODUCTION ENGINEERS AND MAINTENANCE MEN
whose job it is to keep production machinery operating at peak efficiency and who have recognized the superiority of Marvel Synclinal Filters in the filtration of hydraulic oils, fire resistant hydraulic fluids, coolants, lubricants, etc. are specifying Marvel Synclinal Filters on all new equipment and standardizing with Marvel Synclinal Filters on all machines within their plants.
Another outstanding reason for their preference is the simple construction of Marvel Synclinal Filters which allows them to be easily disassembled, thoroughly cleaned and reassembled on the spot, by any workman in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

VISIT OUR EXHIBIT
Booth No. 236
8th National Plastics Exposition
International Amphitheatre
Chicago, Ill.
November 17-18-19-20-21, 1958

Meet J.I.C. Standards

Catalogs containing complete data available on request

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G.P.M. Greater capacities may be attained by multiple installation (as described in catalog). Choice of Monel mesh sizes range from coarse 30 to fine 200.

IMMEDIATE DELIVERY!

For further information, write, wire, or phone or use coupon below.

MARVEL ENGINEERING COMPANY
7227 N. HAMLIN AVE.,
CHICAGO 45, ILLINOIS
Phone: JUNIPER 8-6023

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated: (AH-11)
- ☐ Catalog #108—For Hydraulic Oils, Coolants, Lubricants
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name ..... Title .....
Company .....
Address .....
City ..... State .....

used by one company...

on one type application

enough NYLAFLOW® tubing to lasso the highest flying earth satellite!

So what? Just this! Any company that uses 10 million feet of NYLAFLOW flexible tubing must be well satisfied with the results. And it certainly proves a point we've been making. For "down-to-earth" quality—uniformity you can depend upon—NYLAFLOW pressure tubing gives you the most value for your investment.

Whatever your problem—conveying air, gases or liquids—the characteristics of this tough, flexible polyamide tubing can more than justify its use.

- High pressure rating at low cost
- High resistance to flex and vibrational fatigue
- Mechanically strong—resists abrasion and impact
- Corrosion and chemical resistance
- Serves wide temperature range: low as —100°F, up to +225°F
- Is used with standard flare or flareless fittings
- Light weight (1/7 that of copper)
- Easy to work with . . . easy to install

NYLAFLOW pressure tubing is available in 1000 psi and 2500 psi short time burst strengths. Every lot is pretested for strength, resiliency, impact and cold brittleness. It is 100% proof pressure tested.

NEW LITERATURE now available. Write today for more information on characteristics, properties and uses.

THE POLYMER CORPORATION OF PENNA.
a subsidiary of The Polymer Corporation
Reading, Pennsylvania
Export: Polypenco, Inc., Reading, Pa., U.S.A.

POLYPENCO®

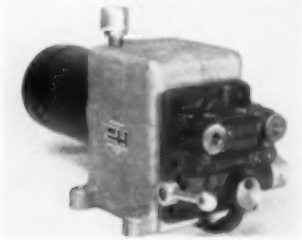
CIRCLE 105 ON TIME-SAVER CARD

NEW PRODUCTS

HYDRAULIC POWER PACK . . . with built-in 4-way valve

Designation: Model 620

Features: Compact, completely integral with 6 or 12-volt motor, pump, 4-way valve and tank. Control lever can be remote operated. Valve has three positions including



spring-return to neutral. Reservoir is aluminum and has a capacity of 110 cu in. Working parts are totally-enclosed for weather protection. Motor is flange-mounted to one end of reservoir and 4-way valve to the other.

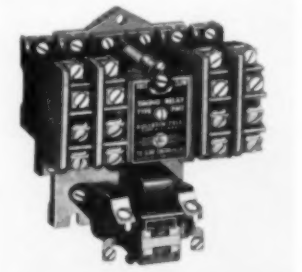
Wisconsin Hydraulics, Inc.
Milwaukee, Wis.

CIRCLE 304 ON TIME-SAVER CARD

TIME DELAY RELAY . . . needs no extra vertical space

Designation: Type TMP

Features: Saves space in panels. Eliminates grouping relays by size. Can be located according to func-



tion in circuit which simplifies wiring. Each pole's two sets of contacts may be used for separate circuits, even with opposite polarity. Front access for wiring. Melamine blocks make barrier between poles and relays.

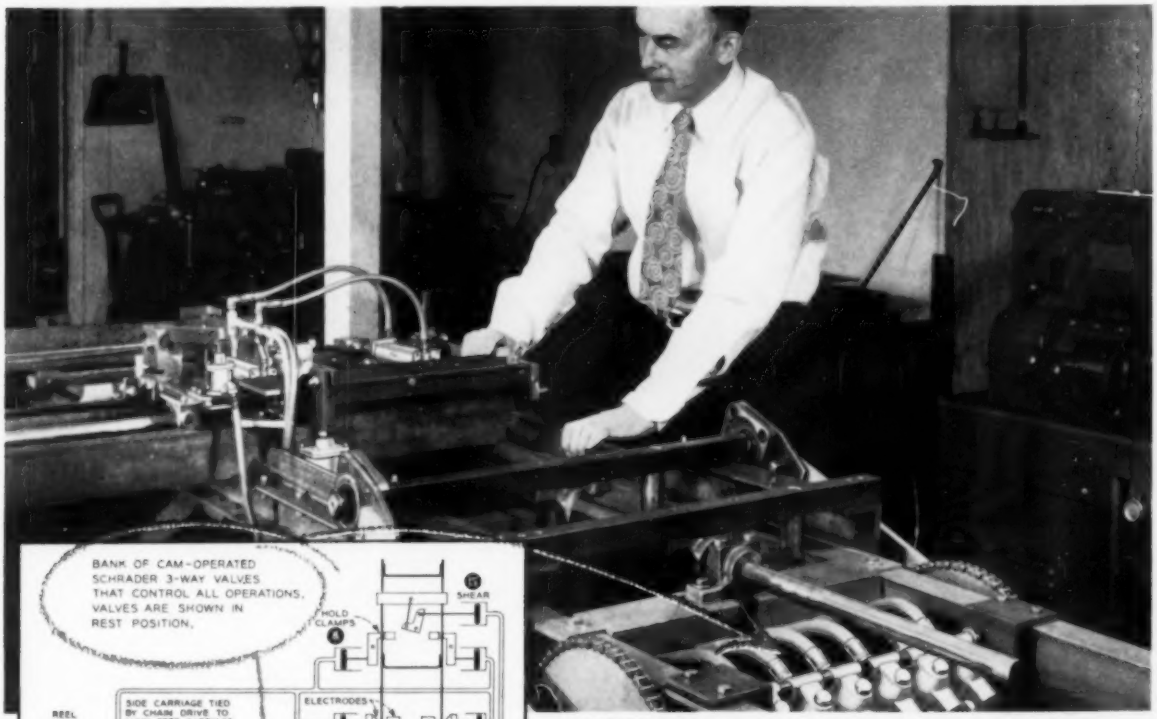
Specifications: Made in 32 varia-

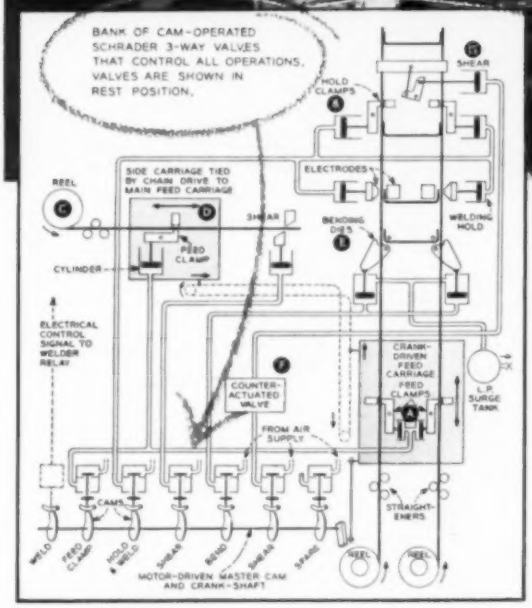
Continued on page 60

YOU, TOO, CAN AUTOMATE IT YOURSELF ...WITH SCHRADER AIR PRODUCTS

Very often you can automate manufacturing operations simply by applying Schrader air controls to existing plant facilities.

Here's a man with ideas who automated a complex job—increased production, reduced unit costs, safely and easily—without making a large capital investment. He did it with a planned Schrader air control system. Chances are excellent that you can do the same thing—with Schrader air products. Air can do an almost limitless range of work: automatic drilling, reaming, clamping and holding, shearing, forming, staking, grouping and interlocking assembly operations for quicker parts handling and assembly.





PROBLEM: Feed heavy wires into machine, shear off pieces, shape them, weld pieces together and eject as finished wire webbing. Fast. Economically. Automatically.

SOLUTION: Air Controls selected from Schrader's complete line. Neat bank of valves—actuated by cams on master cam shaft—operate synchronized system. Clamps A feed wires to holding Clamps B as carriage moves back and forth. Counter-actuated valve F operates cut-off shear G after desired number of cycles. Wire C, fed from carriage D, is sheared, formed by dies E, welded to the other two wires.

RESULT: One man performs *double* the output of three men at a fraction of the cost of a new machine.

Design it yourself! Schrader Air Control components—the most reliable self-contained power units—can help you adapt quickly to your manufacturing needs.

Schrader®
a division of SCOVILL

QUALITY AIR CONTROL PRODUCTS

A. SCHRADER'S SON • *Division of Scovill Mfg. Co., Inc.*
456 Vanderbilt Ave., Brooklyn 38, N. Y.

How do I start? How did others get started? Send me informative literature and information about Schrader's Automate-It-Yourself Air Products.

Name_____ Title_____

Company_____

Address_____

CIRCLE 116 ON TIME-SAVER CARD

NEW PRODUCTS

tions of 5 basic models. Class A models have time delay of 0.2 sec to 3 min with accuracy of ±10 percent. Class B adjustable from 0.2 sec to 1 min with accuracy of ±15 percent. Contacts rated at 10 amps, 600 v.

Clark Controller Co.
Cleveland, Ohio

CIRCLE 305 ON TIME-SAVER CARD

SOLENOID VALVE
. . . is packless

Designation: GV60-565

Features: Stainless steel body and operating parts. No stuffing boxes or sliding glands to maintain. Tight sealing on liquids and gases without close fitting parts. Suitable for low temperatures in missile ground support equipment.

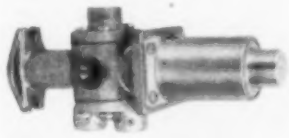
Specifications: For air or gases to 2500 psi and liquids to 1800 psi. Ports are ¼ NPT or AND. Made with NEMA 1, IV, VII, or IX solenoid enclosure.

Automatic Switch Co.
Florham Park, N.J.

CIRCLE 306 ON TIME-SAVER CARD

HIGH-PRESSURE CONTROL VALVES
. . . with dc solenoids

Features: Made in the shear-seal design which is a self-aligning sealing ring in direct contact with a mating



slide. Metal-to-metal sealing surfaces lap themselves with each operation maintaining sealing qualities indefinitely.

Specifications: Direct solenoid operated for pressures to 3000 psi; 12, 24, or 125v dc. Made in shut-off, diverter, 3 & 4-way flow patterns.

Barksdale Valves
Los Angeles, Calif.

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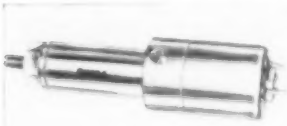
. . . has built-in solenoid valve

Features: Stainless steel body. Three-way, normally-closed solenoid control valve mounted on blind end of cylinder. Mounting nut on front



end. Valve parts can be replaced without removing cylinder from line.

Specifications: Bore 1-1/16 in. Strokes 1, 2, and 3-in. Cylinders are single acting spring return.

Bimba Hardware & Mfg. Co.
Monee, Ill.

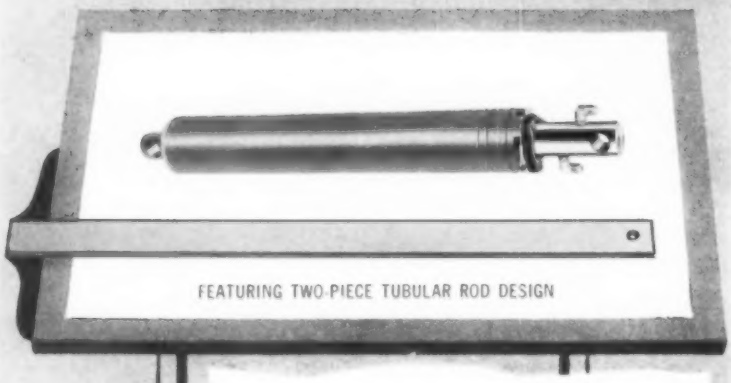
CIRCLE 308 ON TIME-SAVER CARD

For more NEW PRODUCT reviews turn to page 130

BH EW

HOLLOW ROD

Hydraulic Cylinders



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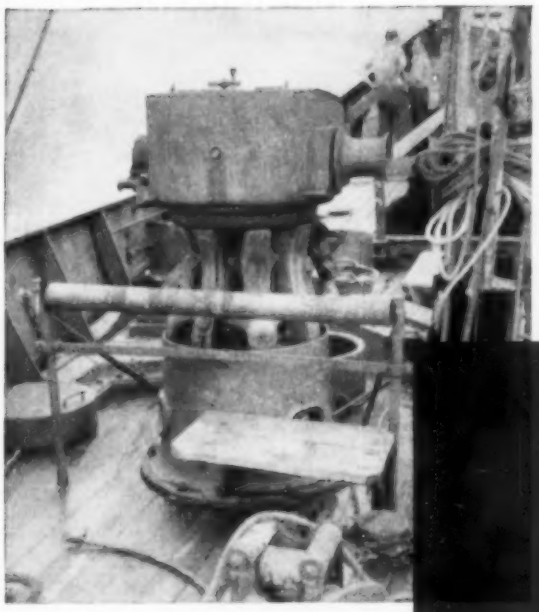
CIRCLE 19 ON TIME SAVER CARD



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CIRCLE 78 ON TIME-SAVER CARD

581

USEFUL LITERATURE

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OIL CONDITIONER . . . and filter which is portable and contains its own pump is covered in a data sheet published by *Mayhew Products Co., Los Angeles, Calif.* The units are made with four types of elements: adsorption for general use, inert type for detergent oils, cleanable felt type for soluble oils, and cleanable porous bronze for special uses.

CIRCLE 400 ON TIME-SAVER CARD

CHECK VALVES . . . with flexible seal seats for hydraulic and pneumatic service are presented in a leaflet published by *Kepner Products Co., Summit, Ill.* It lists information on materials of construction, applications, port sizes, and operating conditions for the check valves which are made in sizes from ¼ to 1 in. The valve's soft seat assures zero leakage at low pressures.

CIRCLE 401 ON TIME-SAVER CARD

COMPRESSION PACKINGS . . . of the sheet and rod type made in roll form or as pre-cut gaskets of natural rubber, synthetic rubber, compressed rubber and asbestos, and laminations are featured in a catalog produced by *E. F. Houghton & Co., Philadelphia, Pa.* It is presented in easy-to-read form with packing recommendation charts for various fluids.

CIRCLE 402 ON TIME-SAVER CARD

CYLINDER TUBING . . . with micro-inch internal finish is covered in a 6-page technical data folder available from *The Babcock & Wilcox Co., Tubular Products Div.* It explains how smooth interior, welded carbon steel tubing can cut production time and reduce costs in manufacturing hydraulic cylinders. Folder also explains the company's ultrasonic inspection.

CIRCLE 403 ON TIME-SAVER CARD

SHAFT SEALS . . . for rotating shafts on pumps, compressors, turbines, and engines are described in a booklet prepared by *Syntron Co., Homer City, Pa.* It gives complete data on dimensions, specifications, and applications of the self-lubricating, pressure-balanced seals.

CIRCLE 404 ON TIME-SAVER CARD

BOOSTERS . . . that produce 22,500-psi hydraulic pressure from 100 psi air pressure are detailed in a catalog announced by *Davies Brothers, Gladstone, N. J.* It contains dimensional charts and output graphs covering the complete line. The catalog also illustrates valves and other accessories used with the boosters.

CIRCLE 405 ON TIME-SAVER CARD

HYDRAULIC CYLINDERS . . . with bores to 16 in. and strokes to 20 ft designed for mobile equipment are shown in bulletin 121 from *Hannifin Co. Div. Parker-Hannifin Corp., Des Plains, Ill.* It has a complete listing of all features of the cylinders and a section covering factors to consider in specifying cylinders.

CIRCLE 406 ON TIME-SAVER CARD

DIAL THERMOMETERS . . . made of 304 stainless steel in angle and straight models are described in a bulletin prepared by *W. C. Dillon & Co., Van Nuys, Calif.* It gives a complete description of the manufacturing and calibrating techniques together with dial ranges for all models.

CIRCLE 407 ON TIME-SAVER CARD

AIR COMPRESSORS . . . vacuum pumps, coolers and preheaters, blowers, fans, and pneumatic conveyors are presented in a booklet announced by *Fuller Co., Catasauqua, Pa.* Thirty photographs, seven drawings, twelve schematic illustrations and eight tables of dimensions and capacities are included in the 12-page, two-color booklet.

CIRCLE 408 ON TIME-SAVER CARD

DRUM-TYPE CONTROLLERS . . . for timing electrical circuits are covered in a catalog published by *Seely Instrument Co., Inc., Niagara Falls, N. Y.* It contains a complete description of operation, use, construction, installation dimensions, specifications, and features of the controllers. Units are made with time scales from 10 to 600 sec.

CIRCLE 409 ON TIME-SAVER CARD

MANOMETERS . . . are detailed in a 24-page engineering guide issued by *King Engineering Corp., Ann Arbor, Mich.* It covers U-type, well-type (single & multiple) and inclined-tube manometers, and accessory equipment. A section tells how these instruments operate and why they are 100% accurate.

CIRCLE 410 ON TIME-SAVER CARD

CYLINDERS . . . for air and hydraulic service are illustrated in three separate bulletins available from *Bendix-Westinghouse, Automotive Air Brake Co., Elyria, Ohio.* The bulletins give complete engineering information including all dimensions parts lists. The cylinders are made with bores from 1½ to 8 in.

CIRCLE 411 ON TIME-SAVER CARD

GEAR PUMP . . . variable displacement type is explained in a leaflet released by *Pesco Products Div., Borg-Warner Corp., Bedford, Ohio.* The pump's operation is described with 3-color schematic drawings showing gear position at zero displacement and at full displacement. Included are suggested applications for aircraft, commercial, and industrial equipment.

CIRCLE 412 ON TIME-SAVER CARD

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QUICK-DISCONNECT COUPLINGS

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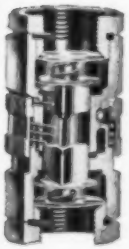

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CIRCLE 119 ON TIME-SAVER CARD

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The Flo-Pac 5 resin-impregnated paper cartridge keeps hydraulic fluids clean at all times. It will not remove additives. Tough, pleated paper provides over 6300 inches of filtering surface. It is designed for high flow rates, full-flow or by-pass filtration, water-base and additive hydraulic fluids.

The K-Type Cartridge, containing 13 pounds of Type "T" Cranite (fuller's earth), removes water, acids and asphaltenes as well as solid contaminants. Cranite is packed solidly in a metal container. K-Type Cartridge is recommended for non-additive type oils and certain synthetics.

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For technical literature and prices, write to Department A11

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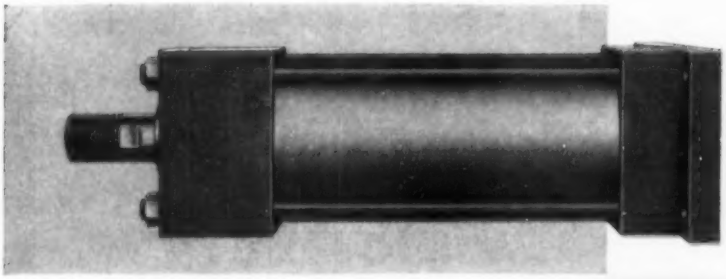
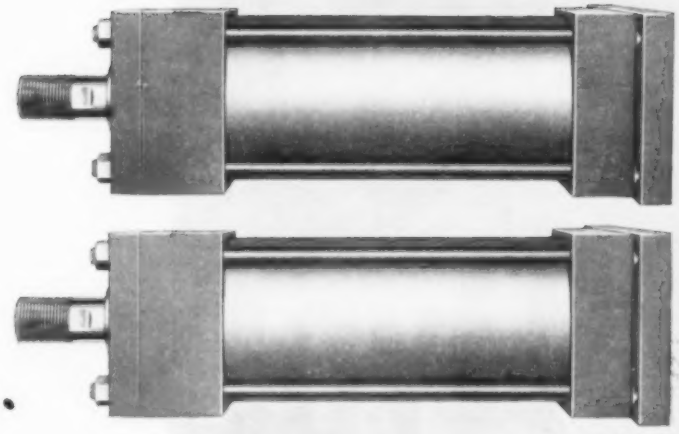
CIRCLE 31 ON TIME-SAVER CARD



◀ A LOGANSQUARE CYLINDER
2 competitors' cylinders
▼

do they LOOK ALIKE? ...sure they do on the surface...



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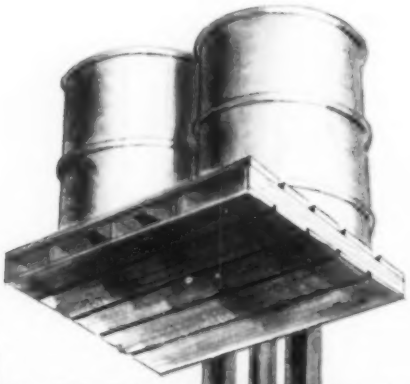
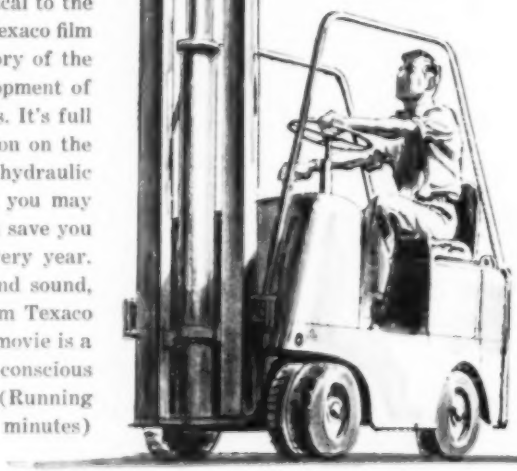


From Pascal to the present, this new Texaco film tells the story of the discovery and development of hydraulic principles. It's full of valuable information on the care of your hydraulic equipment – facts you may not know that can save you thousands of dollars every year. Filmed in color and sound, this new 16mm Texaco industrial service movie is a "must" for every cost-conscious plant engineer. (Running time: 25 minutes)



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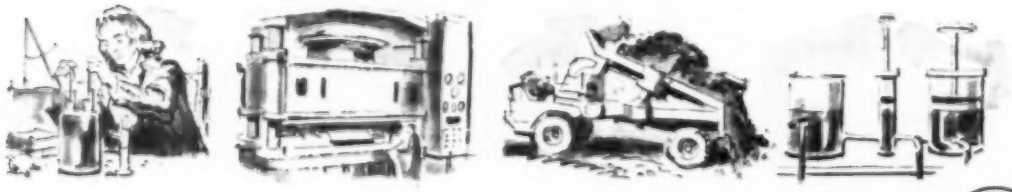
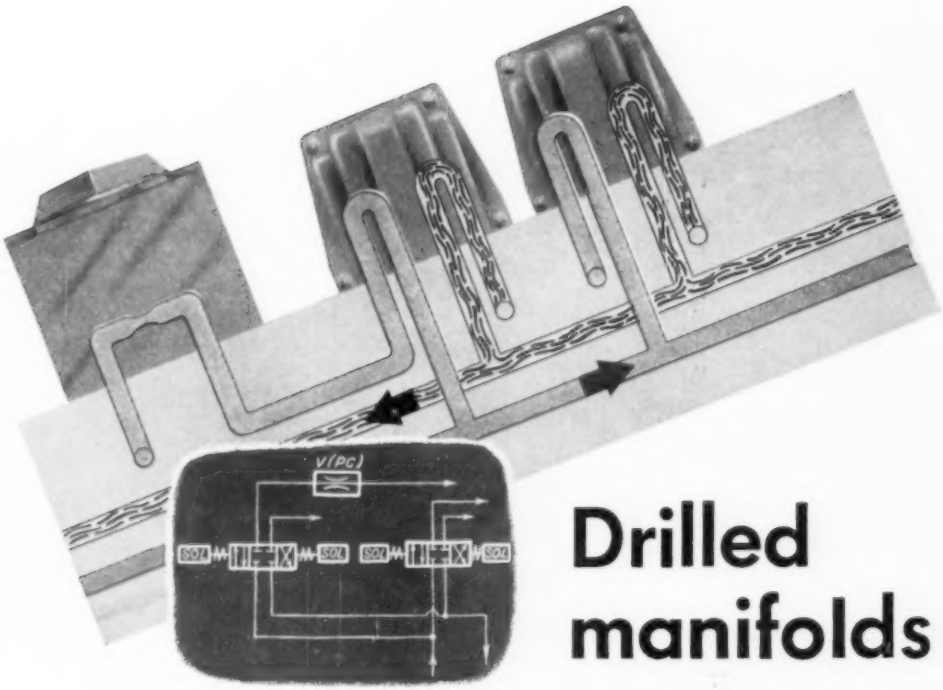


TEXACO

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

CIRCLE 124 ON TIME-SAVER CARD

APPLIED **Hydraulics** & **Pneumatics**
NOVEMBER 1958



Drilled manifolds

• design • manufacture • application

• By Maurice Beshouri, *Hydraulic Engineer, J. N. Fauver Co., Inc., Detroit, Mich.*

This article was awarded fourth prize in the 1958 APPLIED HYDRAULICS & PNEUMATICS *Prize Paper Contest.*

MANIFOLDS offer definite advantages in the design, fabrication, and maintenance of hydraulic circuits. Here's what they can do:

1. Eliminate valve subplates which require that all valve connections be crowded in a small space and limit use of elbow fittings. Subplates are usually made of castings which are susceptible to porosity leaks.
2. Reduce the length of hydraulic tubing and number of connections. Oil passages are shortened, decreasing the pressure drop and volume of oil compressed during cycling. Leakage is minimized.
3. Eliminate labor to cut out valve panels, reducing cost.

However, manifolds are not a complete cure-all. They lack one of the principle advantages of sub-plates which are tapped for connections rather than the valve body. Any mistakes mean scrapping only the relatively inexpensive subplate rather than the valve. This advantage is lost when difficult tapping is done on a manifold. A single mistake in any of the manufacturing operations may ruin it. Scrapping a manifold because of bad pipe threads is expensive. If these threads become damaged or worn in use, the entire manifold must be replaced. Sometimes, however, the hole can be drilled out and an insert welded in place for new tapping.

Manifolds often require complicated drawings. They are usually not flexible for future changes.

• **Standard manifolds**—Most conventional circuits can be manifolded with standard units, since 4-way valves are common to almost every hydraulic system.

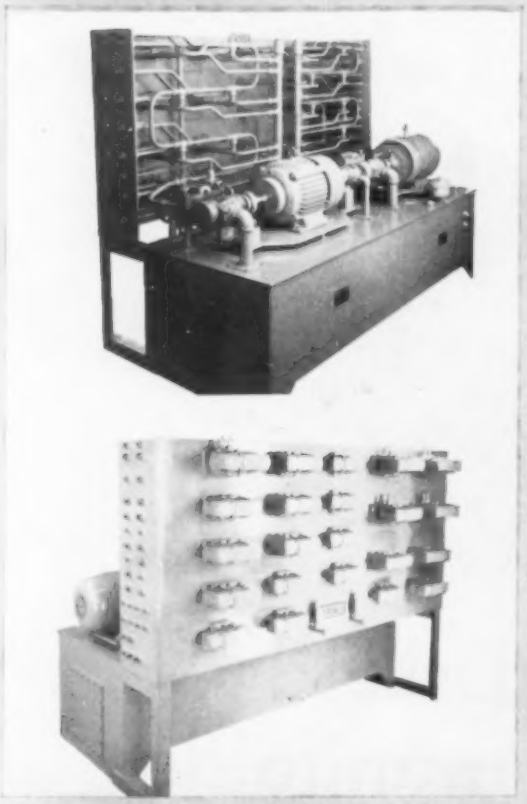


FIG. 1. ALTHOUGH PANEL MOUNTING of valves is easy to design and fabricate, it introduces complex plumbing and many threaded connections.

FIG. 2. THIS PANEL which is assembled from standard sections eliminates cut out valve panels and valve subplates.

Standard manifolds mount any number of valves in sizes from ⅛ through 1½-in.

Sometimes a standard manifold is easily modified to suit a hydraulic circuit. For instance if a check valve is required, it may be incorporated in the manifold by counterboring a seat and using a poppet from a standard check valve. This eliminates a separate check valve which would require a larger manifold. Similarly a globe valve can be incorporated by drilling and tapping the hole for a standard globe valve stem.

Custom-built manifolds meet the requirements of special hydraulic circuits. They cost more than standard manifolds because layout and machining are special.

• **Design**—There is no limitation to the size, mounting and shape of manifolds as long as the drilling can be done. The rules to follow are:

1. Allow at least ¼ in. between long holes, especially with twist drilling.
2. Offset valve ports to eliminate cross drilling.
3. Take advantage of the manifold thickness to mount valves on the sides.
4. Eliminate re-drilling for pipe taps by using the proper size drill during deep hole drilling.
5. Leave enough room between port outlets for elbow connections and tools.
6. Use a letter or number to designate every hole on all views of the drawing with a matching list to show sizes. Group the deep holes in elevations and color each elevation differently.

The thickness of a manifold depends on the location of the cylinder outlet ports. Thin units with cylinder ports at the rear are the cheapest because they can be made from cold rolled steel. This is supplied in mill stock sizes with tolerances of .005 in. A block is sawed off from stock which has the proper width and depth. Only the mounting surface for the valves has to be ground. Finish should be 30-50 micro-inch. The ends can be squared on a shaper.

Locating the cylinder ports at one side or both sides of the manifold increases the thickness and usually requires hot rolled steel. For example, a manifold for four, ¾-in. 4-way valves with cylinder ports at the sides is 4½-in. thick. With rear outlets, it is 2½-in. thick. With hot rolled steel, the manifold block must be flame cut from a mill stock plate. All surfaces must be cleaned, squared, and finished. These processes almost double the price.

In some cases when the cylinder port is drilled

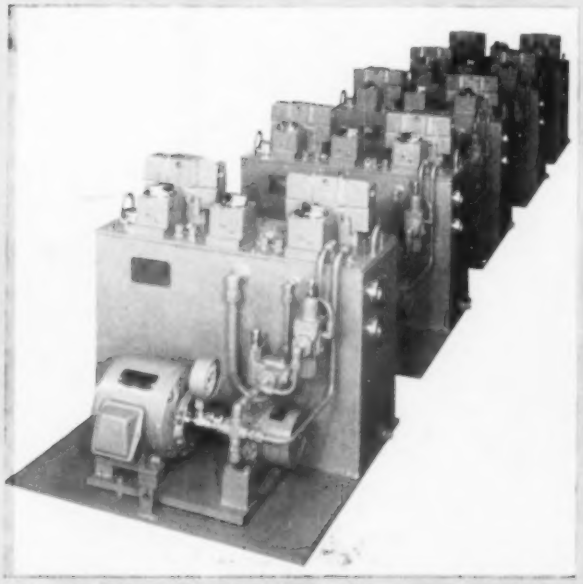


FIG. 3. MOUNTING VALVES directly on reservoir is an improvement towards compactness, but does not solve any of the problems of external hydraulic plumbing.

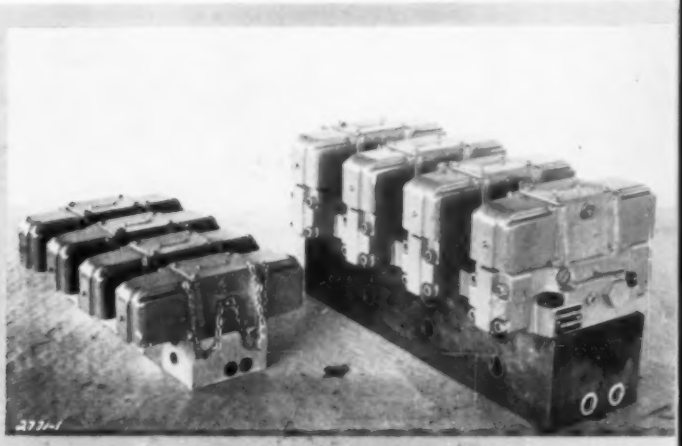


FIG. 4. THICKNESS OF MANIFOLD depends on location of cylinder ports. These are brought out one side of manifold at left, and both sides of manifold at right. Ports at rear give thinnest unit.

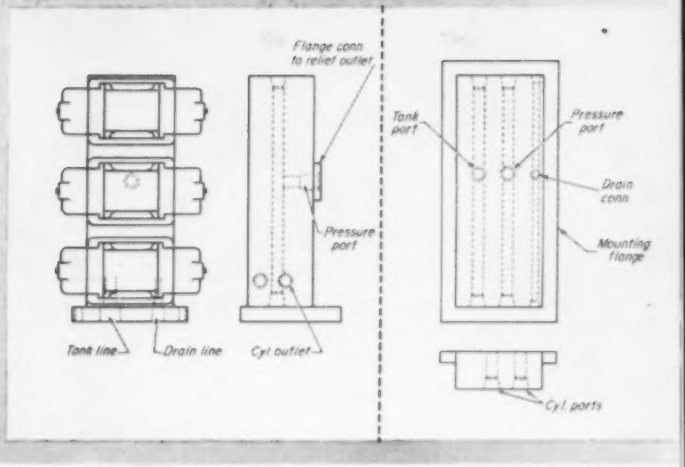


FIG. 5. STANDARD MANIFOLDS accommodate 4-way valves and fit most circuits. Unit at left mounts on reservoir top. Flanges on manifold at right permit panel mounting.

straight through for back outlets, it will interfere with the long tank or pressure holes. Off-setting the cylinder hole relative to the location of the valve cylinder port makes it possible to clear the deep pressure or tank holes. Sometimes the long connecting hole can be offset relative to the center line of the valve port location to clear some other holes which would interfere otherwise.

In complicated manifolds, instead of scattering the inner connecting holes, it is better to group them in different levels relative to the surface. This minimizes set-up time for deep hole drilling. One setting is required for all holes which are located on one plane whether horizontal or vertical. Also, grouping the holes in levels simplifies the manifold layout.

• **Mounting**—Two drilled straps welded to the back of a manifold is the simplest mounting. Pressure, tank and drain lines are connected to the top or bottom of the manifold. Welded flanges permit panel mounting. The manifold body projects through a cut-out in the panel. This is suitable when other valves must be mounted on the panel. All cylinder ports, pressure, tank, and drain lines are accessible from the rear.

Another style of mounting is directly on top of the reservoir. The tank and drain lines are connected with pipe nipples through the reservoir top cover.

• **Drilling**—Twist drilling limits the manifold size because of drill wandering. A hole of 10 to 12 in. will wander as much as $\frac{1}{4}$ to $\frac{3}{8}$ in. A 20-in. manifold can be twist drilled from both ends without objectionable drift as long as it does not affect the function of the manifold. But a drift of $\frac{1}{4}$ or $\frac{3}{8}$ inch means that the designer must allow sufficient clearance. This makes the manifold layout harder. Either angle drilling or off-setting are necessary, since the long hole must be shifted away to provide the clearance to connect it to the valves. Either of these methods requires larger steel stock, and angle drilling requires expensive fixtures.

The big advantage of twist drilling is that it usually does not require special machines or tools. A radial drilling machine and the proper drills are all that is necessary.

The answer to drill wandering is deep hole drilling. Holes longer than 40 in. can be drilled with a concentricity of $\pm$.005-.008 in. Long holes produced by deep hole drills have a high quality of surface smoothness and straightness at high feed rates. Deep

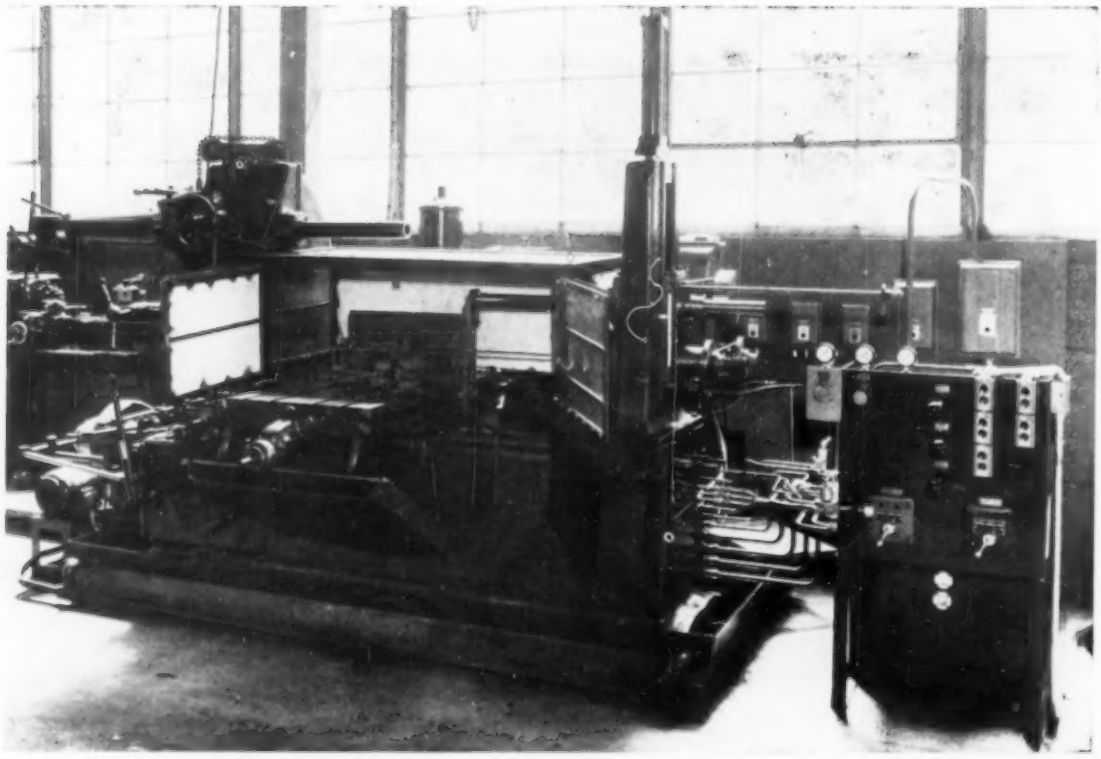


FIG. 6. DEEP HOLE DRILLING MACHINE for making manifolds was built from boring mill. It drills 40-in. holes, 1½-in. diameter with concentricity tolerance of ±.008 in.

hole drilling lowers costs by speeding drilling operations. The tools have long wear life, but they are expensive.

• **Deep hole drilling machines**—They are custom-built, expensive, and not easily adaptable to other machine-shop operations. Unless the machine is used frequently for manifolds and similar components requiring deep holes, it is difficult to justify the investment.

Our company built a machine for drilling holes to 1½ in. diameter and 40-in. long with a concentricity tolerance through the entire length of ±.008 in. The machine was originally a boring mill. We added a high speed spindle (7000 rpm) driven through a pulley and belt by a fluid motor. Belt tension is controlled by an air cylinder. A 20-hp hydraulic power unit having a double, 16-gpm pump powers the spindle fluid motor as well as the table feed which is also driven by a fluid motor.

Flow control valves vary the speed of the spindle from 150 rpm to 7000 rpm. Table speed is controlled for proper feed. The spindle head is positioned vertically by a hydraulic cylinder.

• **Finish**—External leakage is either under the valve or through the pipe taps. Any grooves under the valve O-ring are possible leakage paths. Furthermore, the expansion and contraction of the O-ring gives a pumping action.

Finish on the valve mounting surface should be below 50 micro-inch. The mounting should be ground after all drilling is completed. If the piece is hot rolled steel which is finished first for locating the holes, the mounting surface should be re-ground. Holes must be smooth and accurate before tapping. The tap should be checked frequently with a gage.

• **Testing**—Every completed manifold must be carefully tested for internal or external leakage. Thorough testing is especially important for twist drilled manifolds because of drill wandering. The usual procedure is to mount the valves on the manifold and cycle them at 2000-psi. A pressure gage should be mounted at the tank and drain line connections because slight leakage may not show on the main pressure gage. ▼▼▼

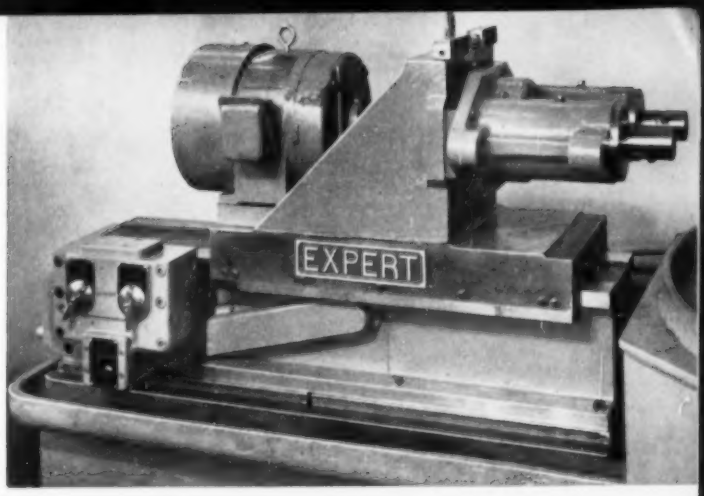
WHICH MANIFOLD?

Big advantages in favor of drilling are economy and simplicity of production. It does not require special manufacturing processes or highly skilled labor.

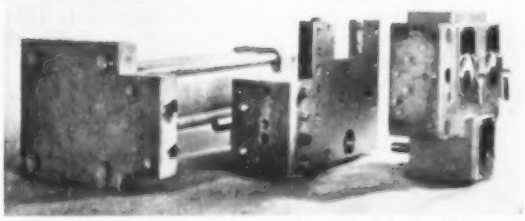
Aluminum manifolds save considerable weight and drilling time, and they do not rust. But they are subject to leakage because the softness of the metal makes it hard to control the pipe taps. Aluminum alloy does not withstand as high pressure as steel, and the manifolds are recommended for pressures below 2000 psi.

How to manifold a feed unit

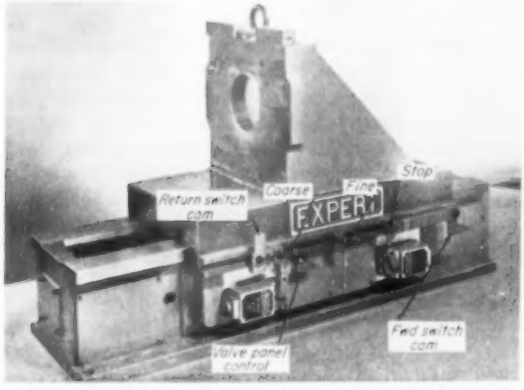
• By H. Brems,
Expert Automation Machine Co., Detroit, Mich.



LONG transfer lines which stretch through a plant are made up largely of hydraulic feed units which drill, ream, and bore the work as it passes along. Every fluid connection which can be eliminated in these standard units is multiplied many times. That's why Expert's manifolded unit has been so successful in eliminating leakage. Study the photos and drawing to see how it's done. ▼▼▼

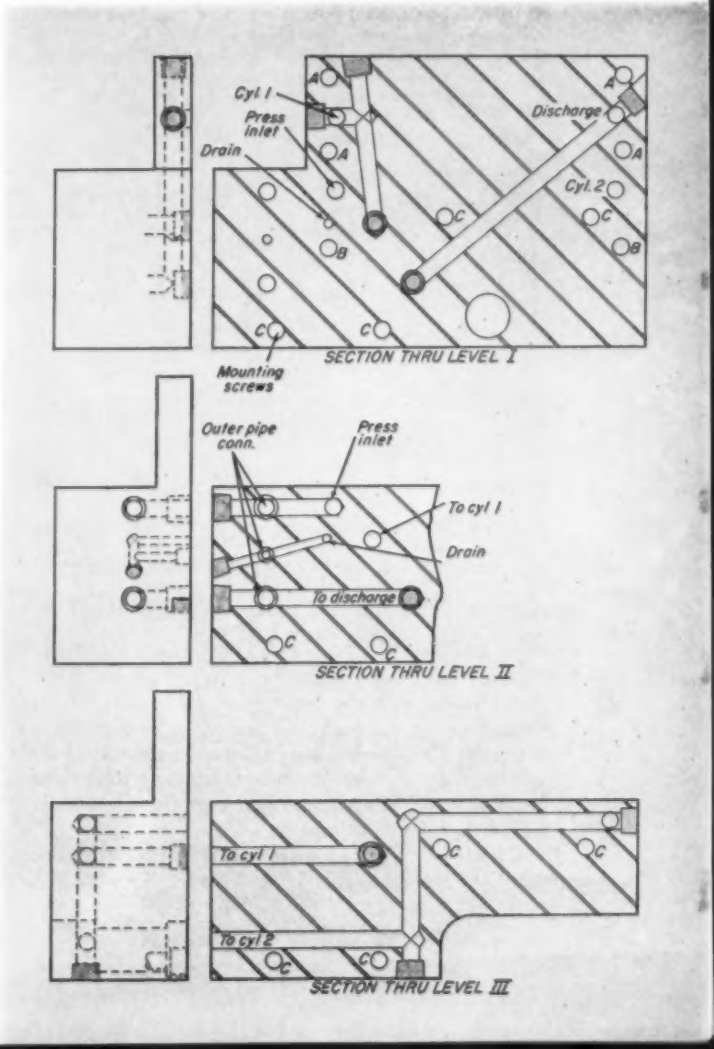


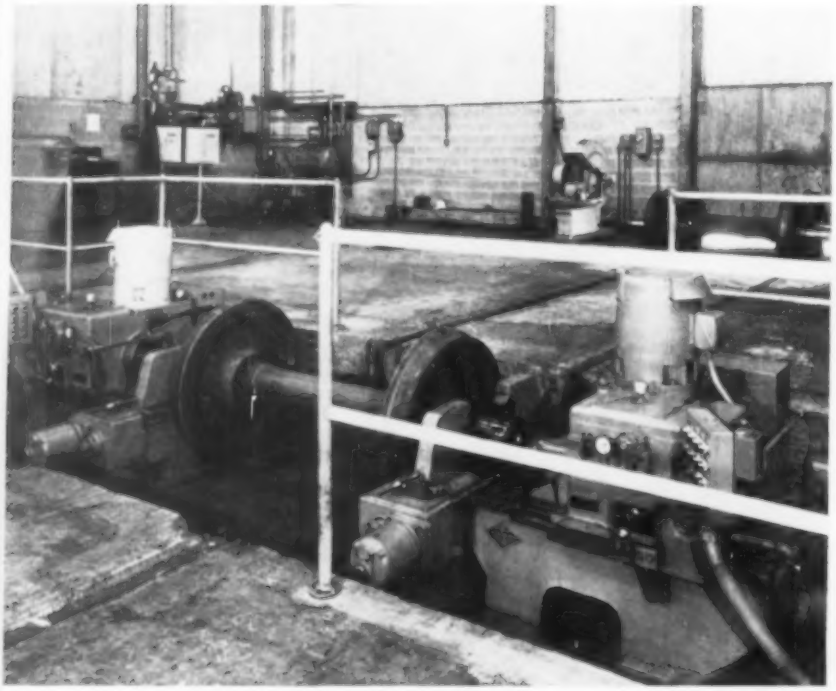
CYLINDER, MANIFOLD, AND VALVE PANEL are mounted together with O-ring seals. Cylinder end-block manifolds fluid to the head end, and through a tube to the rod end.

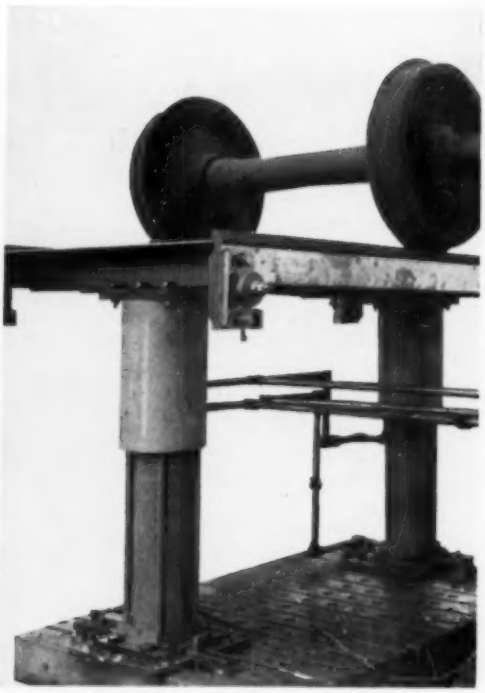


LIMIT SWITCHES sense position of the feed unit to stop it at each end of its travel. Adjustable cams actuate the switches as well as the valve panel control which actuates the valve through a link.

WORKING DRAWING for the manifold uses three sectional views to show hole location. The block is drilled from a dimensioned version of this drawing.







HYDRAULIC ELEVATOR simplifies handling heavy, bulky axle-wheel sets. Centering machine is located in pit. Wheel sets are rolled onto elevator which lowers them into machine. Center photo shows elevator cylinders and power unit. Cylinders have a stop tube welded to inside of rod end cap to limit upstroke to 19¾ in. Elevator operation is electrically interlocked with centering machine.

Fluid motors keep loading

• By Joseph Aprile, *Design Engineer Baldwin-Lima-Hamilton Corp., Hamilton, Ohio*

This article received honorable mention in the 1958 Applied Hydraulics & Pneumatics Prize Paper Contest.

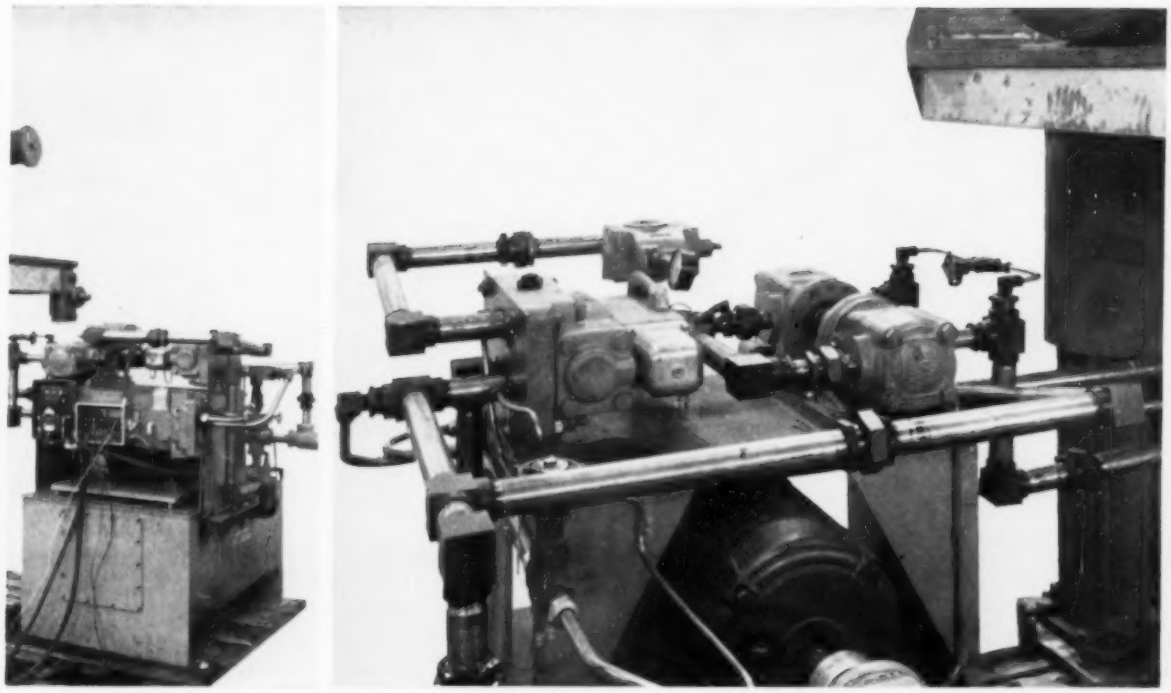
With the relief valve set at 200 psi, and a short duty cycle, low efficiency of a meter-in circuit was no concern on this machine. Mechanically coupled fluid motors make an accurate flow divider.

RAILROAD axle-wheel sets must be removed from the cars after a period of service and re-centered at the ends. Their weight varies from 2000 to 4000 lbs and they are bulky. An eastern railroad solved the handling problem by locating the centering machine in a pit below the floor level.

Wheels are rolled on a set of rails from the outside yard into the building, and onto a loading elevator with a matching set of rails. The elevator has a slight depression at its center to locate the wheels as they are rolled on by hand. After the axles are centered, the wheel set is rolled out of the platform onto the opposite set of rails. Eliminating cranes and slings saves time.

The hydraulic system which raises the elevator has to equalize the flow of oil to two 8-in. cylinders, so that the load is maintained reasonably horizontal during raising and lowering. This is done by dividing flow with two fluid motors, mechanically coupled together.

A needle valve, which is just cracked open, connects the head ends of the cylinders and allows a small bleed at the end of each stroke to make up for any difference in flow. Rapid advance is accomplished with a differential circuit when the UP solenoid is energized. Oil from the rod ends of the cylinders is directed to the pump port of the 3-position valve to join pump flow. The SLOW solenoid is energized near the end of the stroke, forming a bleed-off circuit and diverting part of the oil to tank through a needle valve which adjusts rate.



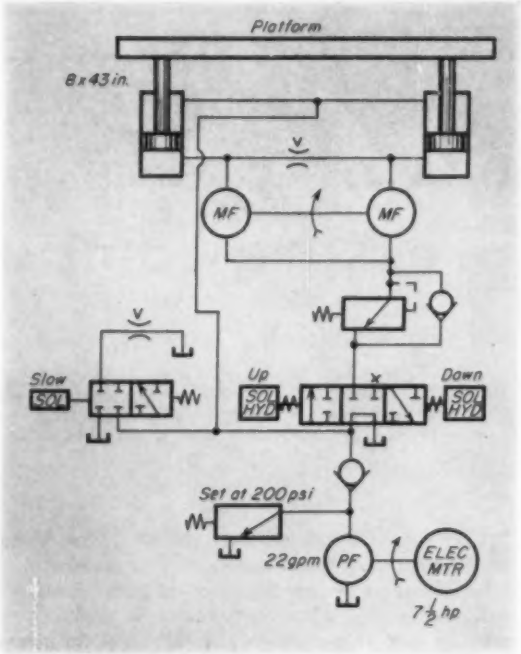
FLUID MOTOR ARRANGEMENT is shown at right with needle valve connected between their outputs. This is opened slightly to make up for any difference in flow to the cylinders and level them at the end of the stroke.

elevator level

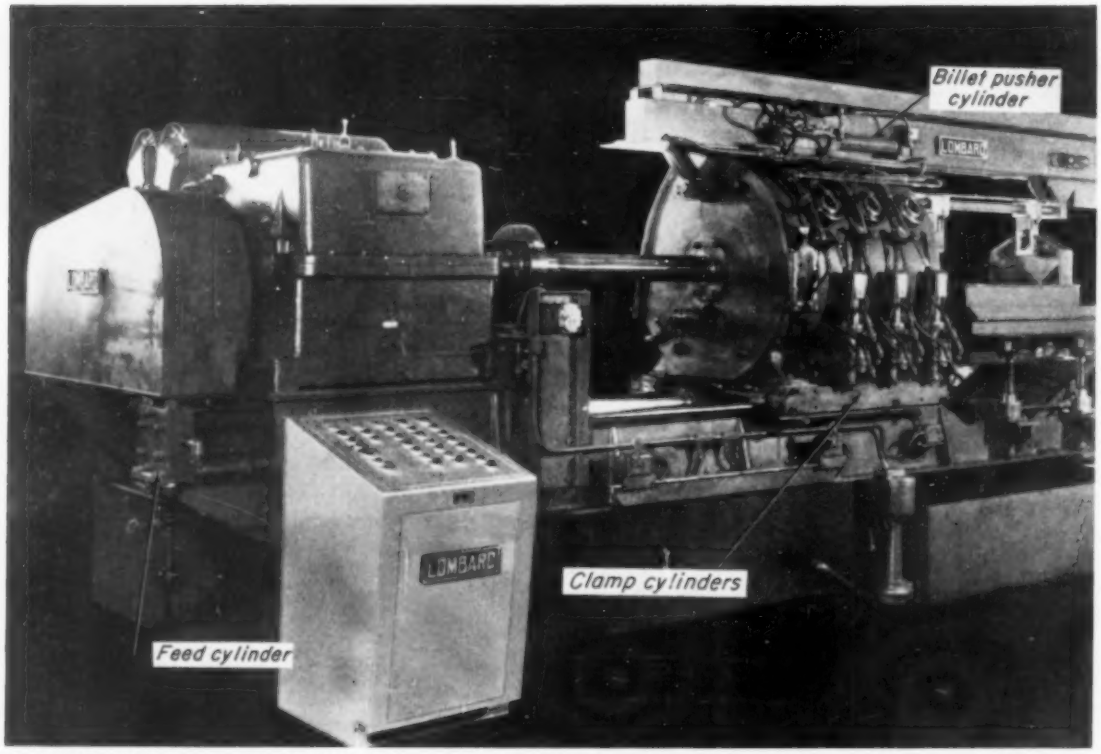
To lower the elevator, the DOWN solenoid is energized directing pump delivery to the rod ends of the cylinders. The fluid motors meter the oil out of the head end to keep the elevator level. The counterbalance valve prevents over-speeding, and the elevator lowers at a speed depending on pump volume. Cushions at the lower ends of the cylinders slow down the elevator at the bottom of its stroke.

• **Machine operation**—The centering machine is hydraulically operated, and its cycle is fast advance, slow feed for centering, time delay, and rapid return to starting position.

Before a wheel set can be rolled onto the elevator, both centering heads must be back all the way to the start position, and the chuck jaws must be open. The elevator can then be raised to loading position. The operations are electrically interlocked, so it is impossible to raise the elevator unless these sequences are followed. Once the jaws are clamped over an axle, the elevator UP buttons are dead. ▼▼▼



22-GPM PUMP SUPPLIES elevator system which drives cylinders up at fast speed of 80 ipm with differential circuit in effect. Slow up speed is adjusted with needle valve controlling bleed-off fluid.



HOLLOW CAST BILLETS ARE LOADED on tray at right of machine. Billet pusher cylinder moves them into carriage through chain and sprocket arrangement. After chucking, feed cylinder retracts to draw work into rotating cutter.

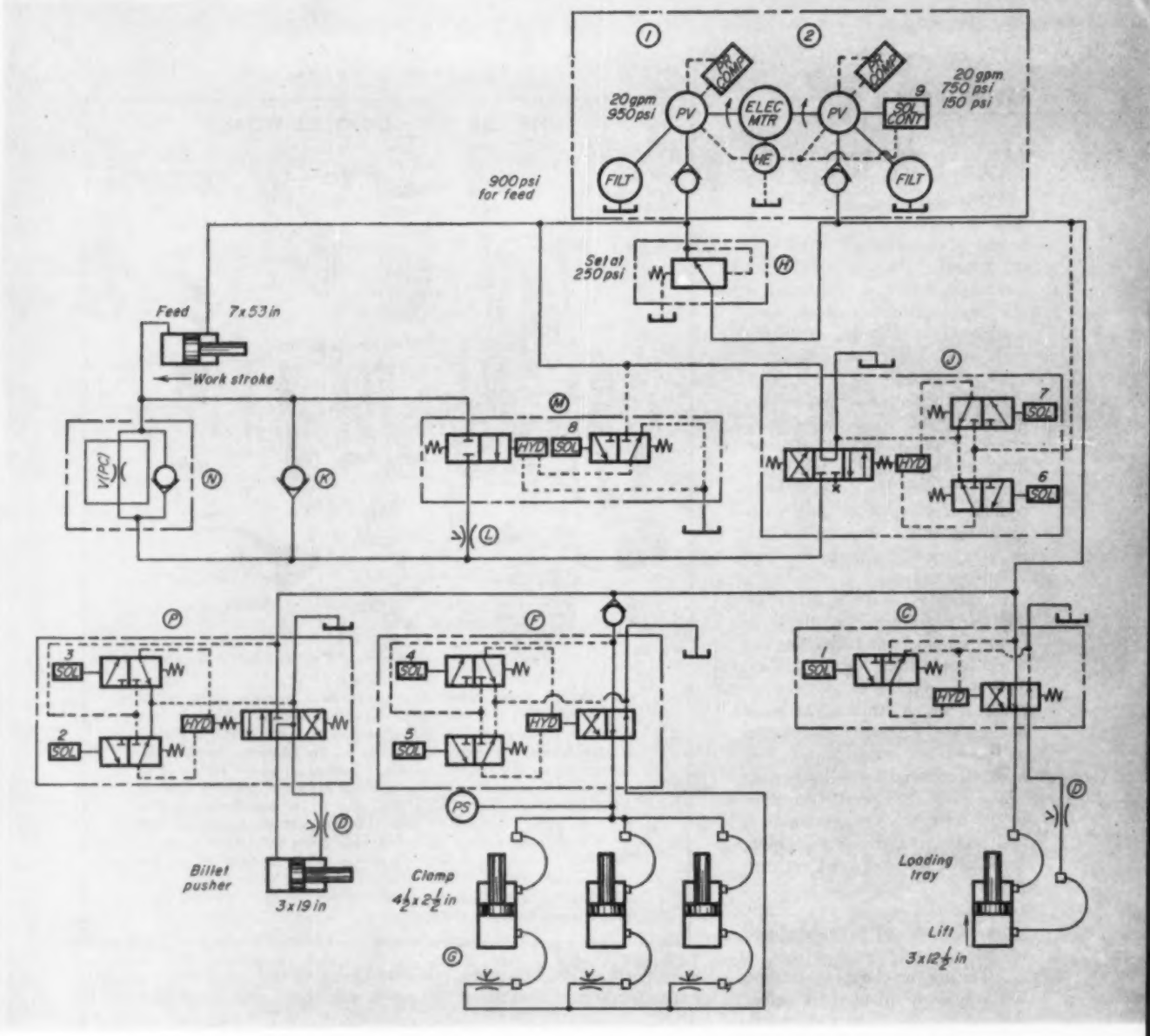
Saving power with pressure-compensated pumps

• By G. A. Mitchell, *Lombard Corp. Youngstown, Ohio*
and Frank M. Magyar, *S. G. Morris Co., Youngstown, Ohio*

PUSHBUTTONS control each operation of a special machine designed to core a hole in an aluminum billet before extrusion. Because the pushbuttons can only be actuated when the operator is ready, pump pressure could remain high while a cylinder was held in one of its extreme positions. With a fixed-displacement pump, fluid would pass over the relief valve at high pressure wasting power and creating heat.

Engineers at Lombard Corp., Youngstown, Ohio, who designed the machine eliminated this waste by using pressure-compensated pumps, and then went a step further with a 2-pressure pump control. Using two pumps to get the required 40 gpm for rapid traverse of the work to the cutter, they compensate one at 150 psi or 750 psi depending on the operation. The other is compensated at 950 psi. This insures that the pumps will deadhead at the lowest practical pressure.

• **Machine background**—The billet corer was developed to meet requirements in extruding aluminum tubing. A billet must have a hole concentric with the outer diameter and with the correct surface finish. Drill presses, boring mills, and lathes served the purpose for machining smaller billets, although concentricity was a problem. As billet size increased with larger presses, these machine tools could no longer



PUMP OUTPUTS COMBINE through valve *J* when pressure at pump 1 reaches 250 psi. Valves *J* and *P* have adjustable throttling orifices in the pilot lines controlling spool shifting speed for smooth starting and stopping action of cylinders. All cylinders except clamps have non-adjustable cushions at both ends.

handle the job, and the wasted metal in drilling a solid billet was too costly.

Larger billets have to be cast hollow, but the inside hole is too rough for extruding without further machining. This would require some of the largest machine tools in the country, plus special transfer equipment to get the billets into and out of the machine.

This is the background in the development of the Lombard billet corer which has accelerated the process, of producing hollow cored billets so it is no longer the bottleneck it used to be. It handles billets up to 2500 lb each from standard transport pallets. It deposits them in the machine, removes the core, then returns them to another transport pallet, ready for heating and extruding. Its capacity is 5 billets per hour for boxes 20 inches in diameter and 50 inches long.

Billets are indexed into the machine one at a time, as finished billets are removed. One row of 50-inch billets or two rows of 30-inch billets can be handled by adjusting the *out* position of the billet pusher.

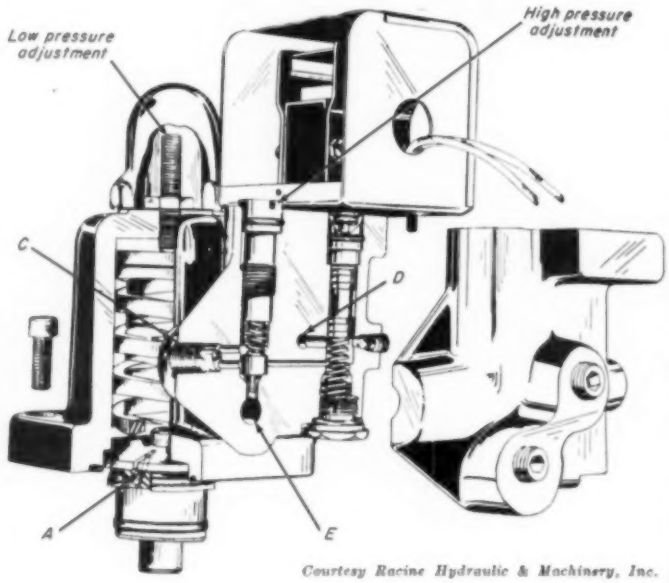
• **Operating sequence**—With the billet on a loading pallet, the operator presses a LIFT switch. This energizes solenoid 1 which locks in through a relay. The pressure control of pump 2 is also energized so this pump will deadhead at 750 psi. The pump de-

livers to the LOADING TRAY cylinder to extend it and deposit the billet on the loading tray. The operator then pushes a DOWN switch which de-energizes solenoid 1 and lowers the LOADING TRAY cylinder. The compensator control of pump 2 is also de-energized, so that the pump deadheads at 150 psi requiring very little power, but providing valve pilot pressure.

When the operator pushes the IN switch, solenoid 2 is actuated extending the BILLET PUSHER cylinder and pushing the billet into the carriage. The compensator control of pump 2 is again energized for this operation, so that the pump can develop the required 750-psi pressure.

Pressing a CLAMP switch actuates solenoid 4 retracting the three CLAMP cylinders and chucking the work in position for machining. This also energizes the pump compensator which remains energized during the following operations until the work is unclamped. The billet is centered by 3-jaw chucks whose jaws are operated together by an internal ring gear, pinion, and rack arrangement. Clamping jaws have 5 settings which may handle any size from 12 to 26 in. OD and 20 to 50 in. length. Only two sets of jaws are used to clamp any one billet.

HOW THE PUMP CONTROL WORKS



Courtesy Racine Hydraulic & Machinery, Inc.

The solenoid pump control is mounted on a pressure compensated vane pump. With the solenoid de-energized, pressure oil bleeds from the pump pressure chamber through orifice A, passage D and Port C to tank. Since no pressure is built up in the governor chamber, the pump shifts to near neutral position, (deadheads) at the setting of its compensator spring. When the solenoid is energized, pressure fluid assists the compensating spring of the pump to increase the pressure at which the pump deadheads. Passage D is then blocked, forcing oil from orifice A, through passage E, and the adjustable relief valve to drain. This allows pressure to build up in the governor chamber to put the pump in high pressure range. Pressure developed by the pump is adjusted by the relief valve. Minimum pressure setting is 100 psi. Maximum pressure setting is 1000 psi.

During the clamping and loading operations, the full volume of pump 1 is unloaded to the reservoir through the open-center, 4-way valve *J*.

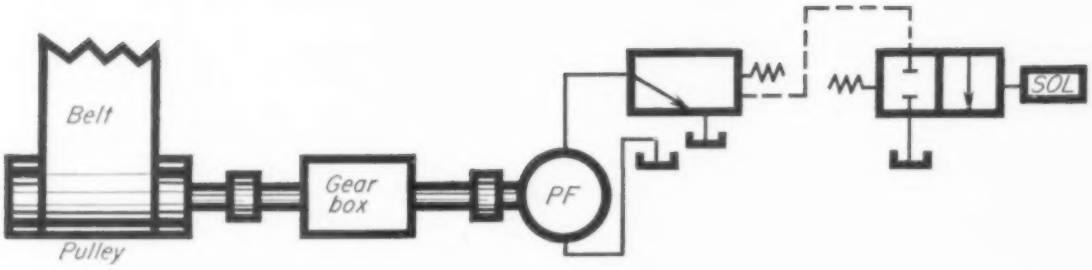
• **Speed control**—When the operator presses the RAPID ADVANCE switch, solenoids 6 and 8 are energized, and the FEED cylinder retracts to advance the work to the cutter. Sequence valve *H* opens to allow deliveries of both pumps to combine. Fluid from the head end of the cylinder passes to tank through flow control valves *N* and *L* which regulate the rapid advance speed.

In manual operation, a limit switch is actuated just before the work reaches the cutter and solenoids 6 and 8 are de-energized to stop the work. The operator then presses the FEED switch to actuate solenoid 6 allowing the FEED cylinder to retract at feed rate discharging its head end fluid through flow control valve *N*. This valve is pressure compensated to insure constant feed rate regardless of load variations.

Any feed from 0 to 60 ipm can be obtained. In automatic operation, the feed rate automatically changes from rapid advance to feed. Since a pressure of about 900 psi is required to feed the work into the cutter, pump 2 deadheads (at 750 psi) and only pump 1 supplies this operation.

To return the work, the operator presses a RETURN switch which energizes solenoid 7. Both pumps deliver to the head end of the FEED cylinder on a differential circuit for rapid return of the carriage. When the carriage reaches loading position, a limit switch deactuates solenoid 7. Pump 1 is unloaded to tank through valve *J* and pump 2 continues to deadhead at 750 psi.

The work is unclamped by pressing an UNCLAMP switch which actuates solenoid 5 and deactuates solenoid 4. Solenoid 5 remains actuated as long as the button is held. When it is released, the compensator control of pump 2 is also de-energized until solenoid 3 is actuated to retract the BILLET PUSHER cylinder. This solenoid remains actuated until the carriage trips one of two limit switches at the end of its stroke. These are selected according to the billet length. ▼▼▼



Braking a conveyor hydraulically

• By Joseph B. Wiley Jr. *Hummel Technical Products, Inc. New York, N. Y.*

PROBLEM: Design a hydraulic system to brake a conveyor at each stop.

GIVEN:
- Speed of the conveyor, 5 ft/sec.
- Moving weight, 400,000 lb.
- Stopping time, 8 to 10 sec.

SKETCHING out the circuit, we drove the pump through a speed increaser, and had it deliver to a relief valve which permitted setting output pressure. This pressure regulated the deceleration of the conveyor. A 2-way solenoid valve in the relief valve venting line is actuated to unload the pump when the conveyor is running. Deactuating the valve forces the pump output through the relief.

To determine pump size, we first calculated the energy which had to be absorbed to stop the conveyor. This was:

$$E = \frac{Mv^2}{2} = \frac{Wv^2}{2g}$$

$$= \frac{400{,}000 \times (5^2)}{64.4} = 155{,}500 \text{ ft lb}$$

The pump's energy absorbtion is its average horsepower consumption multiplied by the time it is driven. Since each horsepower equals 550 ft lb/sec, in 8 seconds 4400 ft lb/hp are absorbed. Dividing this into the 155,500 ft lb which must be dissipated, gives a requirement of 35.3 hp to stop the conveyor in 8 seconds.

If we assume a constant-torque load, the actual horsepower would decrease linearly, so that it averages 35.3. Therefore it would have to start out at 70.6 hp. We selected a pump which delivers 35 gpm at 3000 psi.

Since the pump had to run at 1200 rpm to absorb 70 hp, we had to use a speed increaser from the conveyor pulley. The 36-in. pulley which drives the increaser has a circumference of 113 in. With the conveyor speed of 5 ft/sec, the input to the increaser is 32 rpm. The increaser must have a nominal 1:40 ratio to give the output of 1200 rpm.

Since the energy absorbed in stopping the conveyor appeared as heat in the oil, we had to determine how much oil was required to keep a reasonable temperature.

Using the factor of 778 ft lb/BTU, the 155,500 ft lb which are absorbed in stopping the conveyor each time show up as 200 BTU in the oil. Figuring on a 50-gal reservoir, and taking the specific gravity of oil at .78, this gives 326 lb of oil. With a specific heat of oil of .51 BTU/lb/F, the temperature rise in the reservoir would be:

$$°F = \frac{\text{lb}}{\text{BTU}} \times \text{BTU/lb/°F}$$

$$= \frac{326 \times .51}{200} = .832$$

This temperature rise seemed reasonable based on the frequency of stopping the conveyor. ▼▼▼

THIS 16-IN. SENDZIMIR MILL, at the Forestville, Conn. plant of Wallace Barnes Steel Div., Associated Spring Corp., is one of about fifty in use in this country. Hydraulics plays large part in making these mills accurate.

Hydraulics plus gear train makes precision servomechanism

• By Andrew J. Beck and Robert F. Hargraves

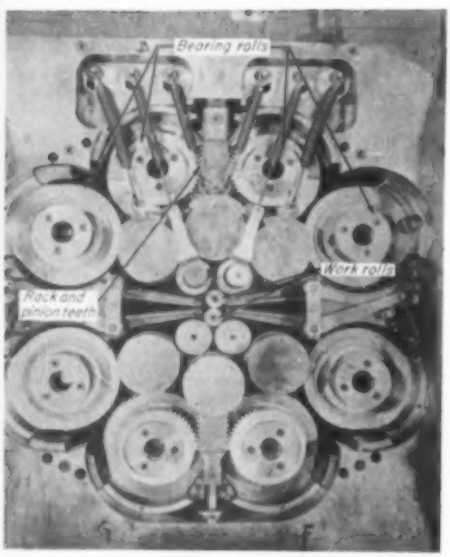


FIG. 1. ROLL CLUSTER of a Sendzimir mill.

A SENDZIMIR mill work-roll cluster is built into a one-piece housing. It's rigidity and the heavy backup rolls, which support the work rolls for their full width, keep the thickness of the rolled strip almost perfectly uniform across the full width. Figure 1 shows the roll cluster and the comparative size of the 1⅛-in. diameter work rolls and the backup rolls.

The photo also shows the bearing rolls. They have eccentrics keyed to them. When the bearing rolls are rotated by hydraulic cylinder-driven racks and pinion teeth, visible in the photo, eccentric motion is trans-

ANDREW J. BECK, *Assistant to the Chief Engineer, Sendzimir Mill Div., Waterbury Farrel Foundry and Machine Co., Waterbury, Conn.;* ROBERT F. HARGRAVES, *Chief Plant Engineer, Wallace Barnes Steel Div., Associated Spring Corp., Bristol, Conn.*

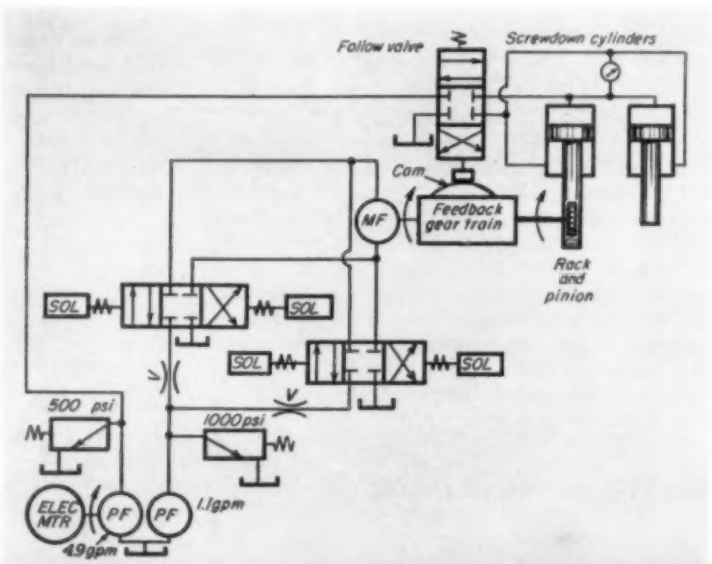
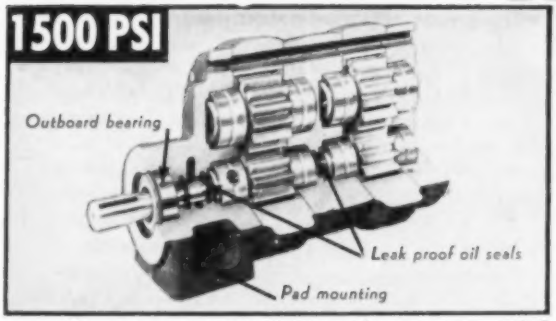


FIG. 2. HYDRAULIC CIRCUIT for positioning work rolls on a Sendzimir mill.

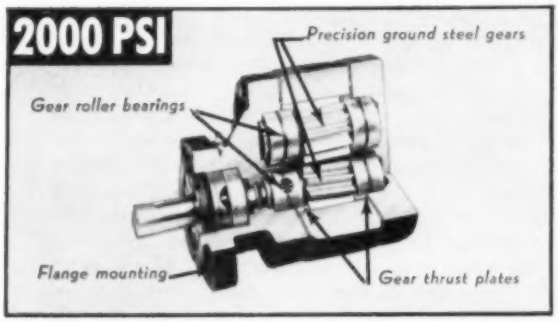
DESIGNER'S CHECK LIST

1500 PSI



Two gear pumps assembled in tandem on common shaft deliver independently—can be piped for dual operation or combined for double capacity single operation. "Pressure Pocketing" reduces slippage, friction and wear—volumetric and mechanical efficiency over 90%.

2000 PSI

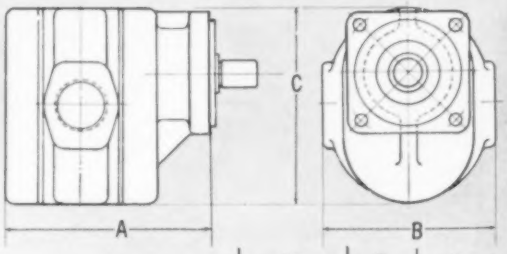


Single gear motor can be piped from side on end ports. Extra large gear bearings maintain shaft alignment; heavy-duty outboard bearing absorbs drive shaft and shock loadings. New leakproof oil seals maintain internal pressure balance.

PUMPS — — — DEVELOP OIL HYDRAULIC POWER
1500 PSI—2 to 100 gpm—continuous duty operation
2000 PSI—12 to 36 gpm—continuous duty operation

MOTORS — — UTILIZE OIL HYDRAULIC POWER
1500 PSI — 2 to 68 hp—continuous duty operation
2000 PSI —12 to 36 hp—continuous duty operation

DIMENSIONAL DATA (Approx.)



		A*	B	C
1500 PSI	C SERIES	4" + gw	4"	4½"
	D SERIES	5¼"+ gw	6½"	6¾"
	J SERIES	7" + gw	8"	9"
2000 PSI	36H SERIES	6½"+ gw	6½"	7⅛"

*When fitted with socket head cap screws. If fitted with hex head cap screws add thickness of head. gw = gear width

Actual performance data for pumps and motors having gear width other than one inch can be computed by multiplying values in following tables by desired gear width.

1500 PSI PUMPS

	AVAILABLE GEAR WIDTHS	SPEED (RPM)	OUTPUT PER INCH OF GEAR WIDTH (gpm at discharge pressure psi) 500	1000	1500	INPUT PER INCH OF GEAR WIDTH (hp at discharge pressure psi) 500	1000	1500
C SERIES	½", 1", 1½"	600	2.3	1.1	0.5	1.2	2.3	3.5
		1200	4.5	3.6	2.6	2.4	4.5	7.0
		1800	7.2	6.0	5.5	3.8	6.7	10.5
D SERIES	½", ¾", 1", 1½", 2", 2½", 3"	600	6.6	6.4	6.3	2.6	4.0	7.0
		1200	13.2	13.0	13.0	5.2	8.0	13.5
		1800	19.3	19.0	19.0	7.5	12.0	20.5
J SERIES	2", 2½", 3", 3½", 4"	600	9.7	9.3	9.2	3.1	6.1	9.0
		1200	20.6	20.3	20.0	6.4	12.3	18.7
		1800	31.0	30.5	30.1	10.2	19.3	29.4

1500 PSI MOTORS

SPEED (RPM)	INPUT PER INCH OF GEAR WIDTH (gpm at input pressure psi) 600	1000	1500	OUTPUT PER INCH OF GEAR WIDTH (hp at input pressure psi) 600	1000	1500
600	4.1	4.7	5.3	0.8	1.4	2.4
1000	7.1	7.4	7.7	1.3	2.4	3.4
1500	9.6	10.4	10.8	1.9	3.5	4.5
600	8.2	8.6	9.0	2.1	3.5	4.3
1000	12.5	13.6	14.0	3.5	5.8	8.0
1500	18.0	19.0	20.0	4.3	8.0	11.2
600	10.6	10.9	11.6	2.8	5.1	7.7
1000	17.1	17.7	18.4	4.3	7.9	12.4
1500	27.0	27.5	28.7	5.1	10.7	17.1

2000 PSI PUMPS

	AVAILABLE GEAR WIDTHS	SPEED (RPM)	OUTPUT PER INCH OF GEAR WIDTH (gpm at discharge pressure psi) 1000	1500	2000	INPUT PER INCH OF GEAR WIDTH (hp at discharge pressure psi) 1000	1500	2000
36H SERIES	1", 1½", 2", 2½", 3"	600	4.7	4.5	3.9	4.7	7.4	8.8
		1200	12.3	12.1	11.7	9.5	14.2	19.8
		1800	20.0	19.3	18.9	14.8	21.4	29.3

2000 PSI MOTORS

SPEED (RPM)	INPUT PER INCH OF GEAR WIDTH (gpm at input pressure psi) 800	1200	2000	OUTPUT PER INCH OF GEAR WIDTH (hp at input pressure psi) 800	1200	2000
600	6.9	7.3	8.0	2.3	3.7	6.2
1000	11.2	11.7	12.7	3.3	5.6	10.2
1600	*	18.9	20.1	*	6.8	14.2

* not recommended for 1" or 2" gears at 1600 rpm

Commercial Shearing & Stamping Company

Dept. A-44, Youngstown, Ohio

COMMERCIAL shearing & stamping

CIRCLE 32 ON TIME-SAVER CARD

motion is transmitted through the intermediate rolls to vary the spacing of the work rolls. Both top and bottom bearing rolls may be moved for setup. Only the top, or screwdown, rolls are operated during rolling. A hydraulic servomechanism maintains constant roll spacing by positioning the top rolls.

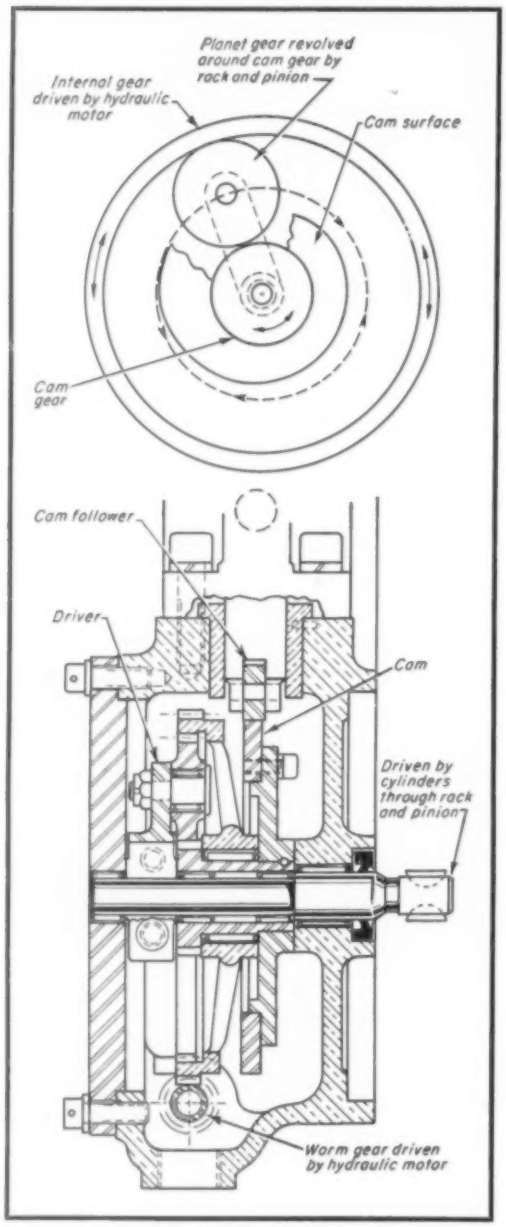

Planet gear revolved around cam gear by rack and pinion
Internal gear driven by hydraulic motor
Cam surface
Cam gear
Cam follower
Driver
Cam
Driven by cylinders through rack and pinion
Worm gear driven by hydraulic motor

FIG. 3. SECTION AND SCHEMATIC of the feedback gear train.

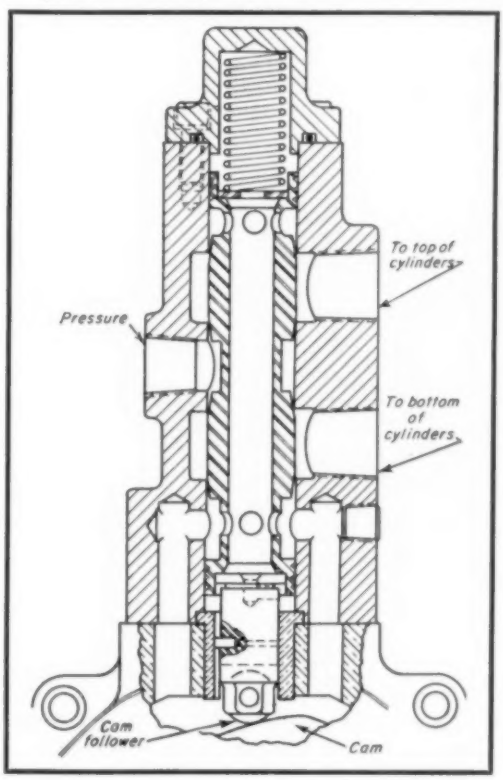
FIG. 4. SECTION OF THE SERVO or follower valve.

• **Hydrauic Servomechanism**—Circuit diagram of the hydraulic servo, Figure 2, shows the two pumps. The larger feeds the servo or follow valve; the smaller feeds a hydraulic motor through one of two solenoid operated, 4-way valves. Two valves are used so the operator may pick fast or slow screwdown speed for setting up. Needle valves in the pressure lines to the valves adjust the speeds.

The feedback gear train, shown in section and schematically in Figure 3, controls movement of the servo valve plunger. When the hydraulic motor is driven, the internal gear drives the planet gear. This rotates the cam gear and cam. As the cam moves, it displaces the servo valve plunger, Figure 4. Movement of the valve plunger directs oil to move the screwdown cylinders which drive the rack and pinion to orbit the planet gear about the cam gear.

These two inputs have the total effect of returning the cam and valve plunger to their original positions. The screwdown cylinders, of course, move to do this. So, by selecting the right solenoid, the operator is able to move the cylinders at high or low speed for setup. With the rolls the right distance apart, the hydraulic motor is stopped. Then, while the strip is being rolled, any tendency for the rolls to change their spacing makes the rack and pinion move the cam and servo valve to correct.

The differential pressure gage between inlet and outlet lines to the screwdown cylinders lets the operator tell when the rolls touch the strip because the pressure suddenly increases. ▼▼▼



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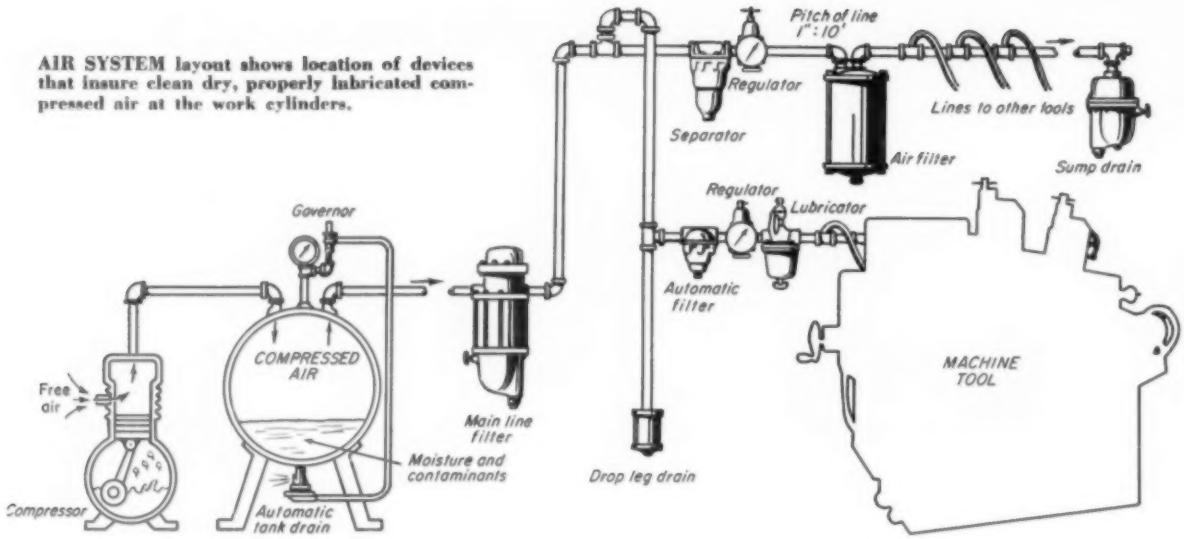

AIR SYSTEM layout shows location of devices that insure clean dry, properly lubricated compressed air at the work cylinders.

Most machine builders put filters on their pneumatically powered equipment. These can't be expected to remove all contaminants that form in the compressor and main headers.

Take care of your air

• By Don W. Benner, *Wilkerson Corp., Englewood, Colorado*

CLEAN compressed air begins at the air compressor. Does the compressor suck in heated air from a furnace? Does it bring in extra moisture from a steam operation? Does it suck in dirt from a cleaning or machine operation? Has the compressor got an efficient filter and is it cleaned regularly? These questions must be asked if trouble in compressed air lines is to be avoided.

• **Trouble at the air tank**—Contaminants get sucked into the tank. Every 9½ cubic feet (roughly) of dirty atmospheric air is squeezed down to make one cubit foot of adiabatic compressed air, and the temperature is raised to as much as 485°F (at 100 psi in a single-stage compressor). Moisture is added to this cubic foot of compressed dirt, fumes, oxygen, nitrogen and argon at this high temperature. On a day that has a relative humidity of 60% and a temperature of 70° each cubic foot of atmospheric air contains about 5 grains of water. Since a grain equals .007 pounds, in a cubic foot of atmospheric air there would be .035 pound of moisture in vapor form. Squeezing 9½ of these atmospheric cubic feet into one cubic foot of compressed air, brings the moisture to about .3 pound plus the dirt, oil by-passed from the compressor crank case, and other contaminants. The 80-gallon air tank used in so many shops, has at 100 psi about 100 cubic feet of free air, containing 3 pounds of moisture or about .4 gallons of water. What a horrible mess this can all amount to when mixed with the dirt and fumes at high temperatures! Getting rid of this goo should start at the tank after everything has been done to prevent it at the compressor intake.

Put an automatic tank drain on the tank so that when there is an accumulation the tank is purged. If the tank is not drained several times a day, it could fill up so that air storage capacity is lost and the compressor runs longer, wasting power and causing wear. Tank drains quickly pay for themselves.

• **Main line filter**—Some moisture stays in suspension and moves out to the main lines. Aftercoolers are some help but usually they are not enough. They do not remove micronic particles, fumes, or compressor oils, and they permit these to circulate to the machines in their worst form: dry.

Good protection is provided by a single-unit, 2-stage separator-filter with an automatic drain installed

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RŌTAC Rotary Torque Actuators consist of a cylindrical chamber containing a stationary barrier or shoe, and a central shaft with a fixed vane. With fluid or pneumatic pressure applied to either side of the vane, rotary movement in the opposite direction is obtained; power can be doubled by using double-vane shafts. One moving part insures long life and low maintenance.

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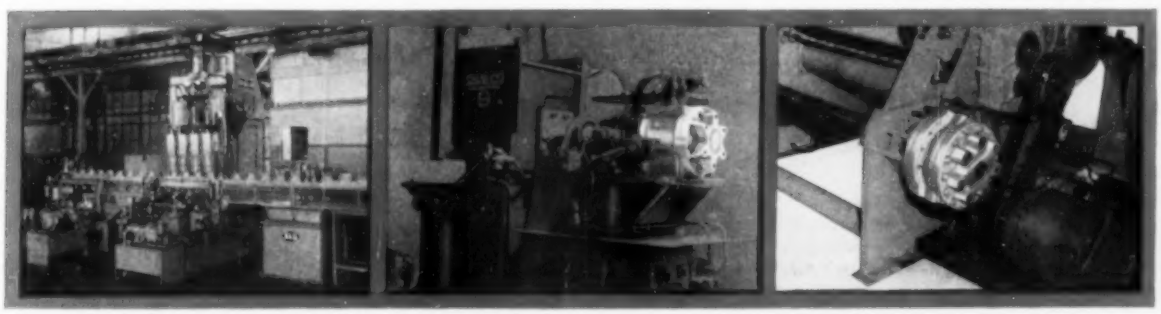
MOBILE EQUIPMENT—A compact RŌTAC Torque Actuator swings this truck-mounted crane boom in a 280° travel arc; it's controlled through a 4-way valve.



MACHINE TOOLS—Automation machine for boring and grooving piston wrist pin holes uses RŌTAC Torque Actuator for positioning the orienting arbors.

FOUNDRY MACHINERY—Ex-Cell-O Model HN-66-1V RŌTAC Actuators supply the motive power for turnover of the core-box on this semi-automatic shell core blower.

PAPER MACHINERY—This collector roll is actuated by a standard model RŌTAC Actuator which unloads material after a slitting operation is performed.

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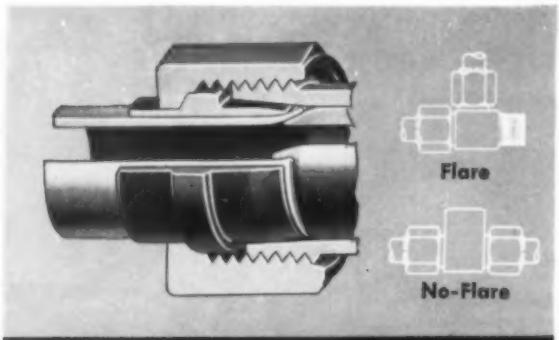

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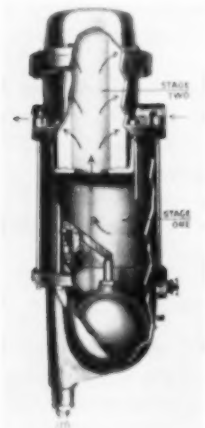
TAKE CARE OF YOUR AIR

in the main line as far from the compressor as possible and just before the first branch line of the system. This takes out the moisture that has condensed by cooling while traveling from the compressor to the branch line.

In one stage, the moisture and large contaminants are trapped and automatically removed as they accumulate. Then the relatively clean, dry air moves into the second stage where the absorbent filter element strains out micron-sized particles, and absorbs oil fumes and odors.

• **At the machine**—Because there will be some cooling and condensation in all piping runs, each point where air is taken from the system should be equipped with an inexpensive automatic separator to remove any



CROSS-SECTION of a 2-stage separator-filter. It is installed in the main line just before the first branch line of the system.

additional condensation, pipe dope, and scale before air is used for anything. Here, the machine builder's responsibility begins. A machine's pneumatic circuit should be planned so only one connection is necessary, and a filter should be installed on the machine at that point. If it is a large machine, like a transfer machine, supplementary smaller filters to remove condensed moisture may be required at different stations, because air cools further while it travels through the air lines. The filter at the main air connection of such a multiple station machine should be a float-operated, automatic drain type. The secondary ones can be piston-operated type automatic drain units.

• **Lubricators**—An important step in proper care of air is the use of air line lubricators. Putting a measured amount of oil into the air stream keeps components operating freely, reduces wear, keeps packings pliable, and protectively coats metal surfaces against corrosion. The lubricator should be one that can be filled without shutting off the air line. It should have a sight flow gauge so the operator can see if lubricant is entering the air line, and at what rate. It should have a fill hole that can be easily located. Where there are many small air cylinders being operated, the lubricator should work on at least 1 cfm of air flow. The bowl of the lubricator should have a petcock to drain moisture, which settles under the oil. Here again a tamper-proof adjustment knob is usually best. ▼▼▼

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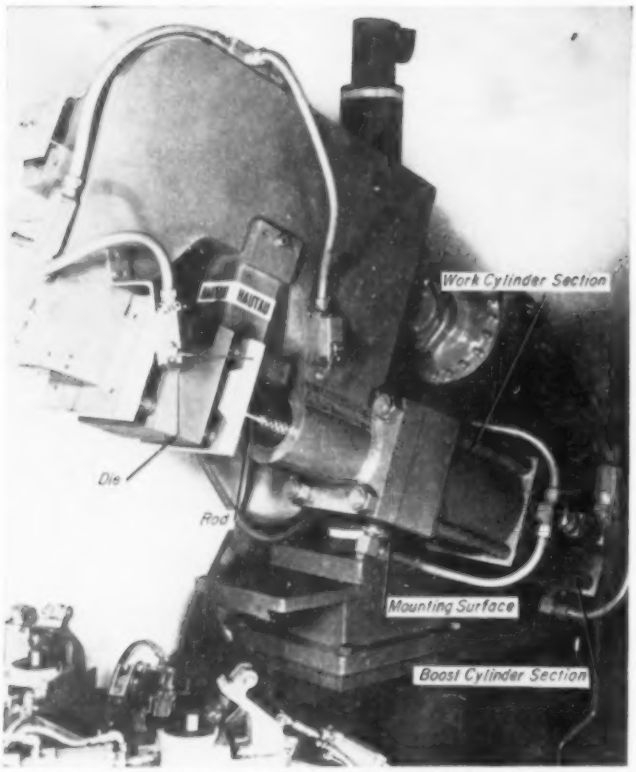

BOOSTER-CYLINDER makes a compact installation for forming, piercing, and chamfering wheel rims. Complete machine has three of these units, one for each operation.

Booster-cylinder unit reduces piping

• By Bruce Barton, *Sales Engineer, and* Robert Gignac, *Design Engineer**
Petch Manufacturing Co., Detroit, Mich.

HIGH forces can be gotten hydraulically from either a large bore cylinder, or high pressure. Large bore cylinders are big and heavy. If high speed is required, lines and pump sizes must be sized accordingly. Cost of large cylinders is also a limiting factor. System cost may be prohibitive if high speed is required. Thus, a small cylinder, working at higher pressure is usually preferable.

To get this high pressure, the engineer chooses between a complete high pressure system, or boosters. The high pressure system has advantages: Smaller components and faster cylinder speeds. Eliminating boosters cuts the number and cost of components.

High pressure systems also have disadvantages. If only a few of the machine functions need high force, a 2-pressure system would be necessary. Such a system would be expensive. It would also be inefficient, if high pressure were needed only intermittently. Selecting components for high pressure systems is a problem, especially at 5000 psi and above. Maintenance may be expensive and controlling leaks may be difficult at this pressure.

• **Need for a Booster-Cylinder**—The new booster-cylinder was developed for a wheel-rim forming, piercing, and chamfering machine which had hydraulic transfer and work mechanisms. A force of 140,000 lb was needed for the metal working operations. The other machine functions could be powered at 1000 psi. At this pressure a cylinder of over 13-inch bore would be needed for the high force. This cylinder would need more than twice the pump capacity. Furthermore such a cylinder could not be mounted on the machine. Clearly higher pressure had to be used.

Since 1000 psi was enough for everything except metal working, booster equipment was decided on instead of a separate, high pressure system. Two things made a single booster-cylinder attractive: a. It would eliminate high pressure piping between a separate booster and cylinder; b. it would make a compact unit needing the least mounting space.

CIRCLE 39 →

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If you have an application for a quality-built, miniature solenoid that will stand up under heavy industrial use, it will be worth your while to investigate Decco's 01 and 02 series miniatures.

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BOOSTER CYLINDER UNIT

• **How It Works**—Operation of the booster-cylinder is shown in the circuit drawing. Although several methods can be used to sequence flow, two directional valves accomplish sequencing on this machine.

When solenoid *C* is energized, oil is directed to cylinder port *C* for rapid advance of the work piston. When the piston meets the work, solenoid *A* is energized admitting fluid to booster port *A*. The booster ram advances, seals off port *C* and develops intensified pressure on the work piston. The piston then completes the high force work stroke.

Solenoids *A* and *C* are then de-energized, opening port *A* to tank; and solenoid *B* is energized, admitting oil to ports *B* and *D*. This returns the booster-cylinder to starting position.

• **Cylinder Size**—To calculate the size of the booster-cylinder, the required output force and the system pressure must be determined. The rapid advance and work stroke must also be known. They can be determined from the operation. Then a booster pressure ratio must be tentatively selected, so that the size of the booster ram can be determined. To determine the length of ram stroke that is needed to complete cylinder travel from the point that port *C* is sealed off to the end of the work stroke, the work stroke is multiplied by the ratio of cylinder area to ram area.

For fast operation, the hydraulic ram stroke should not exceed the cylinder diameter. If the calculated ram stroke is too long, a new ram diameter should be selected and the entire problem recalculated. Determination of the best size then becomes a problem of trial and error.

• **Sample Calculations**—In the piercing operation for wheel rims, The calculated force with a 1.25 safety factor was approximately 140,000 lb. The system pressure was to be 1000 psi. The work stroke included 5½ inches rapid advance and a ½-inch work stroke. A booster output pressure of 5000 psi was tentatively selected. The area of the cylinder was then:

$$A_c = \frac{140{,}000}{5000}$$

$$= 28 \text{ sq. in.}$$

The diameter of the standard cylinder for this area is 6 in.

The area of the booster ram is then calculated as:

$$A_r = \frac{28 \times 1000}{5000}$$

$$= 5.6 \text{ sq. in.}$$

and the corresponding diameter is 2.7 in.

The ram stroke can now be determined:

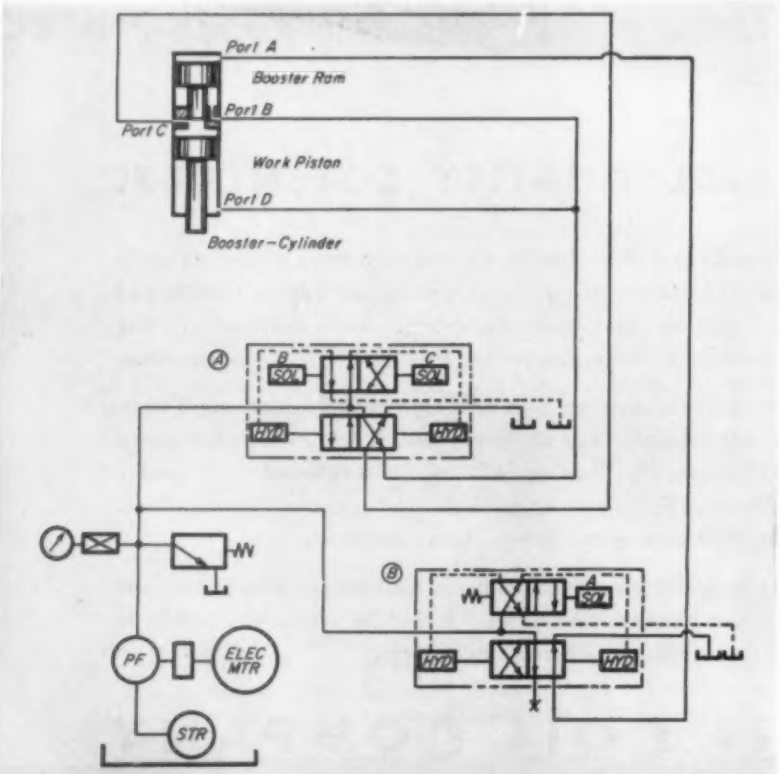
$$S_r = \frac{\frac{1}{2} \times 28}{5.6}$$

$$= 2.5 \text{ in.}$$

The ram stroke was increased ½ inch over the calculated value to compensate for any leakage past the ram. Leakage would decrease intensified pressure. It is limited by the increased length of ram stroke. The intensified force can then be maintained over a longer period of time.

Where possible, standard, commercial cylinder parts were used in the design of the booster. Use of standard head, pistons, and tie-rod construction reduced cost. Special parts were required only for the center housing, cap, and work piston. Since the work piston was guided by ball bushings, a hardened and ground chrome plated rod was used. Packing for the work piston and booster piston is piston rings. The blank end of the work piston has a non-adjustable cushion; the blank end of the booster piston has an adjustable cushion. ▼▼▼

* Robert Gignac was Controls Engineer at Hautau Engineering, Ferndale, Mich. when this article was written.



DIRECTIONAL VALVES control sequencing of booster-cylinder in this circuit. A combination of directional valves and sequence valve could also be used.

CIRCLE 132

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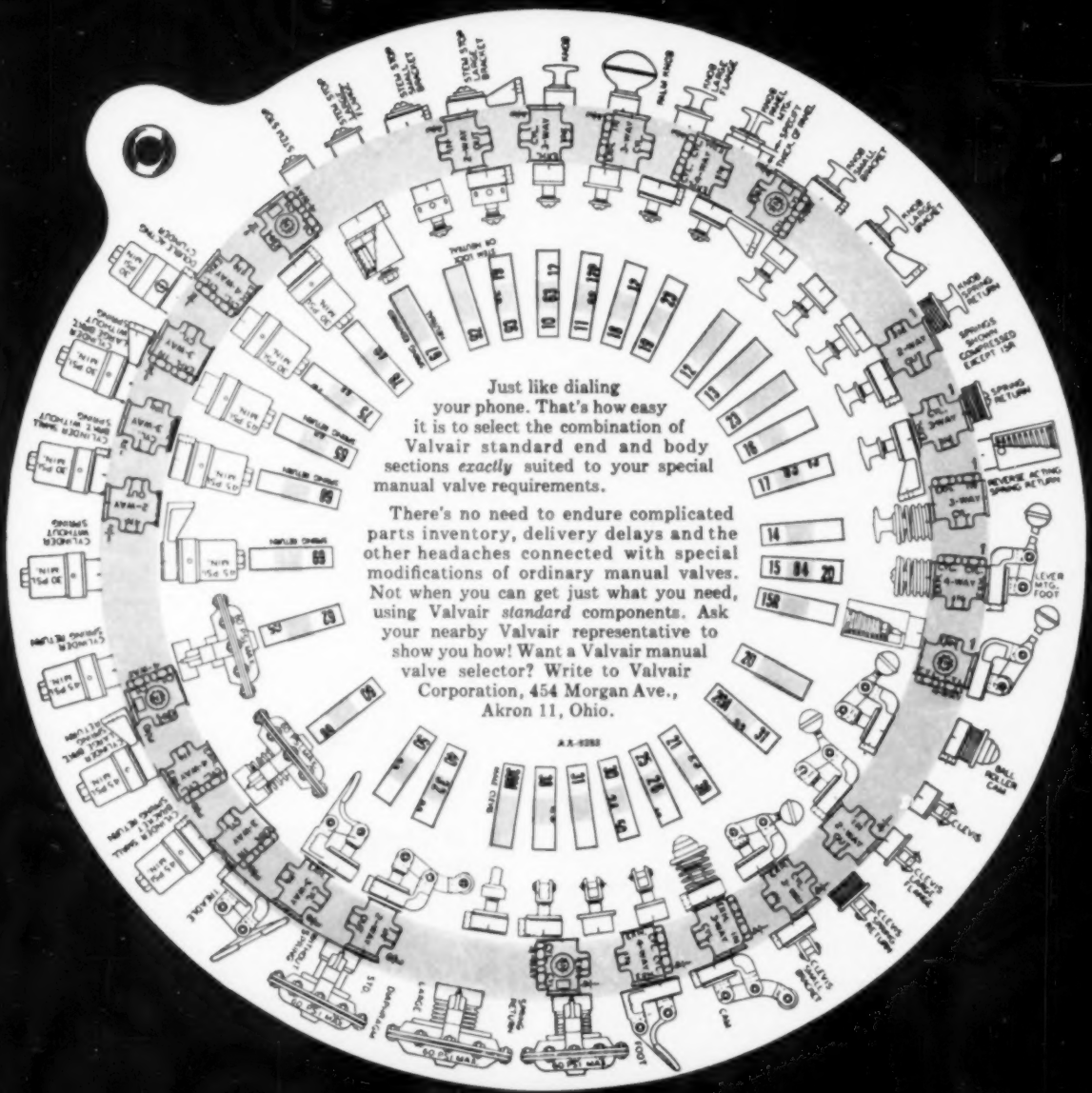

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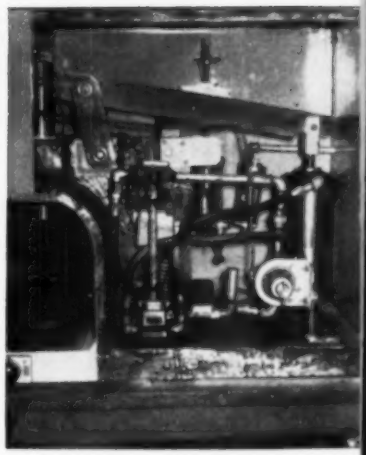

A 5:1 LEVER on this air operated press gives the same ram force with an 8-inch diameter cylinder that you could get from a 16-inch cylinder on a direct acting press.

The lever pivots about a pin mounted in the press structure. The longer arm is attached to an 8-inch bore, 10-inch stroke air cylinder. The shorter arm to the press ram. When the cylinder travels its full stroke the ram moves 2 inches. A hydraulic check, connected to the lever, slows down the cylinder when the ram meets the work. The first 1¼ inch of ram travel is at rapid-traverse. Then the hydraulic check takes over. Ram speed can be controlled by adjusting the hydraulic check.

• **Dual pressure**—Line pressure is used for fast approach and retraction. Reduced pressure is used during the work stroke. A 2-position, 3-way solenoid valve, controlled by a limit switch, directs high or low pressure air to the cylinder.

A normally-open solenoid shut-off valve in the discharge line is used for inching during setup. The

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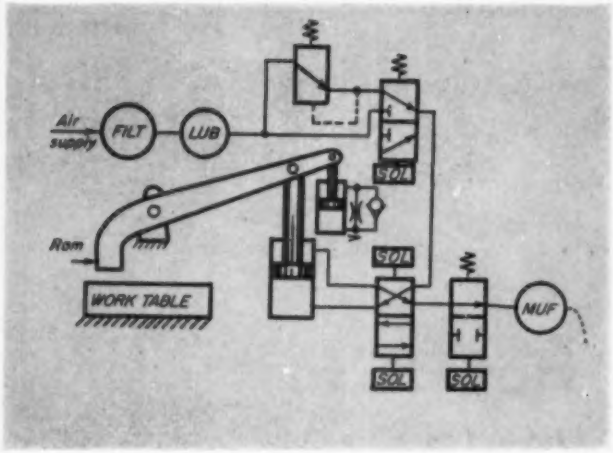

solenoid on this valve has an electrical tie-in with solenoids on the main cylinder valve. Separate push-buttons for inching up and down are mounted on a control panel.

For automatic cycling, a limit switch at the bottom of the stroke starts an adjustable timer for dwell time. It times out to return ram to starting position.

Two limit switches give a 2 in. shut height adjustment.

With 80-psi air pressure the ram will deliver a force of 10 tons. ▼▼▼

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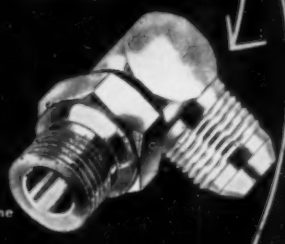

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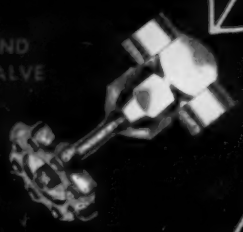

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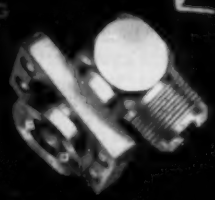

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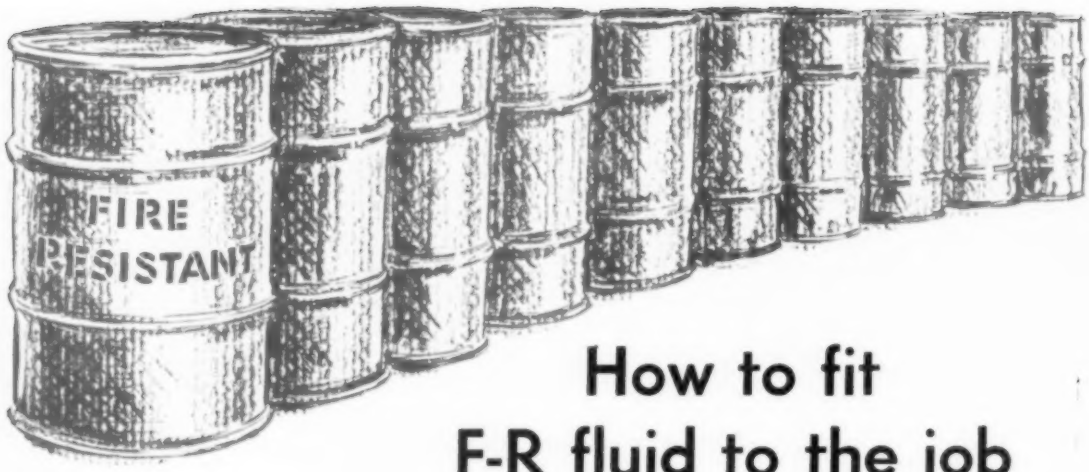


How to fit F-R fluid to the job

• By John Mathe, *Hydraulic Engineer*
E. F. Houghton & Co., Philadelphia 33, Pa.

USERS have a choice of four types of F-R fluids: water-glycol, phosphate ester, mixtures of phosphate ester with chlorinated materials, and water-in-oil emulsions. At least a dozen manufacturers together sell about 30 brands, of varying degrees of F-R, at prices of about $1.25 to $5.00 a gallon.

You can count on a premium-grade petroleum fluid to work in just about any hydraulic system, but F-R fluids won't give the same performance in all types of hydraulic equipment. You must closely match the fluid to the system, because if any redesigning is needed, you will want to keep it to a minimum. By careful selection, you'll almost certainly be able to find an F-R hydraulic fluid for nearly every job.

Although you can use phosphate ester in more systems than any other fluid, it won't work everywhere. It, and water-glycol fluid too, is not wholly satisfactory in some vane pumps. Its high density (as with all F-R fluids) tends to aggravate the cavitation caused by restricted pump intakes. The few troublesome vane pumps, however, can be modified to work with almost any F-R fluid.

• **Bearing fatigue**—Under heavy loads, ball and roller bearings last longer in phosphate-ester fluids than in water-base fluids. Our own experience shows:

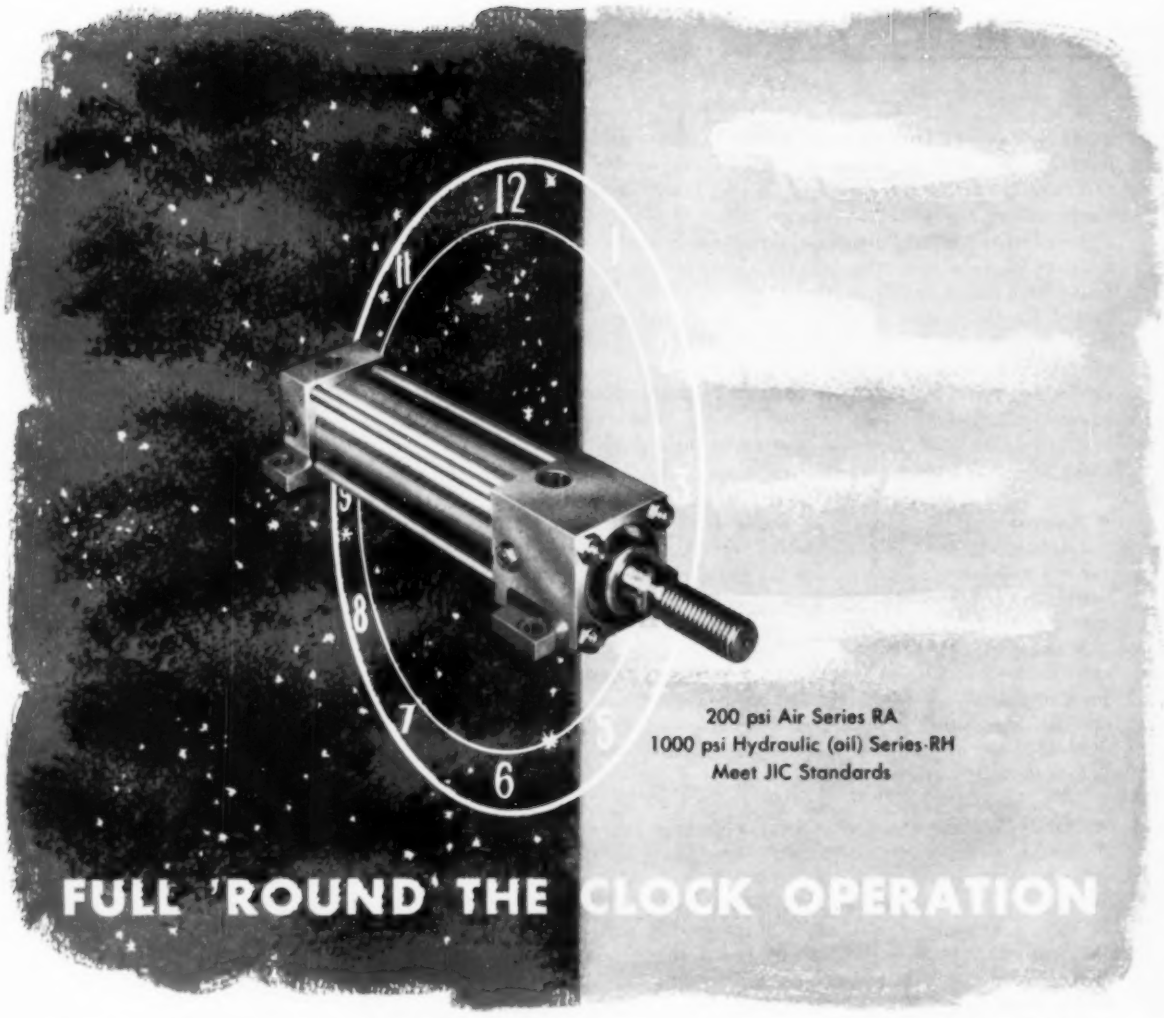
1. Balanced vane pump bearings carry negligible loads and have good life in water-base fluids.
2. Axial piston pump bearings usually are big enough to last a long time in water-base fluids, but there are a few pumps with such peak-loaded bearings that you should not risk them in water-base fluid.
3. The same goes for some gear pumps. Plain sleeve bearings last very well.
4. Radial piston pumps generally have exhibited poor life with water-base fluid. The bearings tend to wear out too fast and unusual amounts of rust form in the pump case.
5. Screw pumps perform excellently on water-glycol fluid.
6. Put plain bearings in unbalanced vane and gear pumps and they will have ample life on water-base fluids.

• **Packings and seals**—Water-glycol fluids don't harm standard rubber packings. They shorten the life of standard leather packings only a little. Water-glycol harms cork composition shaft seals, but these are becoming a rarity. Those in use can be replaced easily with rubber seals.

If you use a phosphate ester fluid, follow these rules for packings and seals:

1. Change dynamic seals to butyl rubber, silicone, or Teflon.
2. You needn't change static seals.
3. Change packings either when you put in the fluid or wait until they deteriorate.

Table I summarizes field experience with competitive phosphate ester fluids. We thought the good results with fluid A were so unusual they warranted study. We found that the system had few packings, that the pump shaft had a mechanical seal without a rubber sealing element, that there were very few valves, and that the cylinder rods had fabricated duck and neoprene packings. Different phosphate ester fluids (cases



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2 and 3, Table I) affected butyl rubber packings differently. This is to be expected; Table II shows the results of laboratory tests made to see how much various phosphate esters swell various packings.

Summarizing, solid Buna N packings are unsuitable with any phosphate ester fluid. Butyl rubber is little affected by fluids A and D, and affected appreciably by B and C. Authorities say that packings should not swell more than 15%. Some phosphate ester fluids on the market swell packings more than that. Our analyses showed that fluids B and C contained appreciable amounts of chlorinated material; fluids A and D none; and this is the main reason why some of these fluids make rubber deteriorate worse than others.

• **Corrosion**—Phosphate ester fluids don't corrode metal, but they don't protect it either when conditions are wet and humid. They behave the same as straight petroleum oils. You can fortify phosphate ester fluids with conventional petroleum rust inhibitors, if need be.

Water-glycol fluids corrode zinc and cadmium, and can't be used with them. Water-glycols will keep iron from rusting if you keep up the pH, but beware of contamination by other fluids and prolonged overheating over 150F). Sometimes it depletes the additive and lowers the pH.

• **Analyzing the fluid**—Normally, only once every 6 months is enough, but be careful! You pay a high price for contamination, and we've found plenty of it. We've inspected many industrial samples, found 70% of them contaminated with oil. For the greater part, the contamination is negligible (1%), but sometimes it runs from 5 to 50%, and occasionally to even 100% where someone refilled with the wrong fluid. It's easy enough to skim oil off water-glycol, but it's not easy to get oil out of a phosphate ester fluid—and if you don't, it will ruin your butyl packings.

• **Fire resistance**—the tests:

1. Spray flammability test—Fluids are sprayed, at various pressures, through a flame. This test simulates the common industrial hazard of a burst line spraying fluid into a furnace. The test is dependable; you get about the same answer every time. The water-glycol fluids cannot be made to burn in this test. The phosphate ester fluid will burn, but not with a sustained flame. Emulsion fluids burn in this test, sometimes with a sustained flame.
2. Pouring fluid-on-molten-metal test—Water-glycol fluids don't ignite in this test until most all water has boiled away. Then they burn with a low flame (much lower than an oil flame). Oil-water emulsion fluids also do not ignite until the water boils away, but then they burn with high oil flame, sometimes erupting violently. Phosphate ester fluids do not burn in this test as long as the fluid or its fumes are not directly in the flame. Phosphate ester fluids don't burn when in contact with surfaces as hot as 1,100 F. Above this they may ignite spontaneously. Around bare flames they will burn at much lower temperatures, but they resist continuous propagation of flame.

TABLE I
Field experience with phosphate ester fluids

FLUID	EQUIPMENT	PACKING CONVERSION	RESULTS
Phosphate ester A	Hydraulic controls	None	No leaks, no difficulty for one year
Phosphate ester A	Diecasting machine	All dynamic packings changed to butyl material	No leaks
Phosphate ester B	Diecasting machine	All dynamic packings changed to butyl	Leaks, packing deterioration in less than 6 months

TABLE II ASTM Rubber Swell Test

Volume change in per cent after 168 hours at 158°F

Fluid Phosphate ester	Butyl Rubber	Buna N Rubber	Fabricated Duck and Neoprene
A	3	89	30
B	30	77	48
C	37	92	57
D	3	68	35

• **Fire-resistance**—the conclusions:

1. Phosphate ester fluids have excellent hot surface fire resistance. In direct flame they flash at relatively low temperatures (470°F.), in this respect being inferior to water-glycol fluids. However, the flames tend to go out.
2. Water-glycol fluids have excellent fire resistance to bare flames. Hot surfaces (over 1,000°F.) will ignite them. After ignition they usually burn with a low flame. Their fire resistance is severely reduced if the water content is depleted.
3. Water-oil emulsion fluids are less fire-resistant than other F-R fluids, but safer than petroleum oils. They are well worth considering especially when there is little fire hazard.

The advent of new fluids may increase rather than reduce the confusion, of which there is plenty already. One of the problems to be overcome is the inability of users to pick the right fluid. ▼▼▼

The following reprints on fire-resistant hydraulic fluids are still available.
Price: 10 cents each.

Changing To Fire-Resistant Fluid?
By J. R. HEMEON, July 1955
Taking the right steps will protect your investment in the machine and will insure maximum efficiency of the fire-resistant fluid.

Fire-Resistant Hydraulic Fluids—Aqueous Base Types
By W. H. MILLETT, June 1957
Properties, Installation and Control

Fire-Resistant Hydraulic Fluids—Phosphate Ester Base Types
By F. H. LANGENFELD, August 1957
Discusses Viscosity, Lubricity, Non-Corrosiveness and Stability

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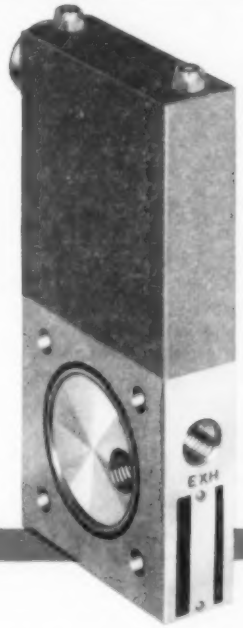

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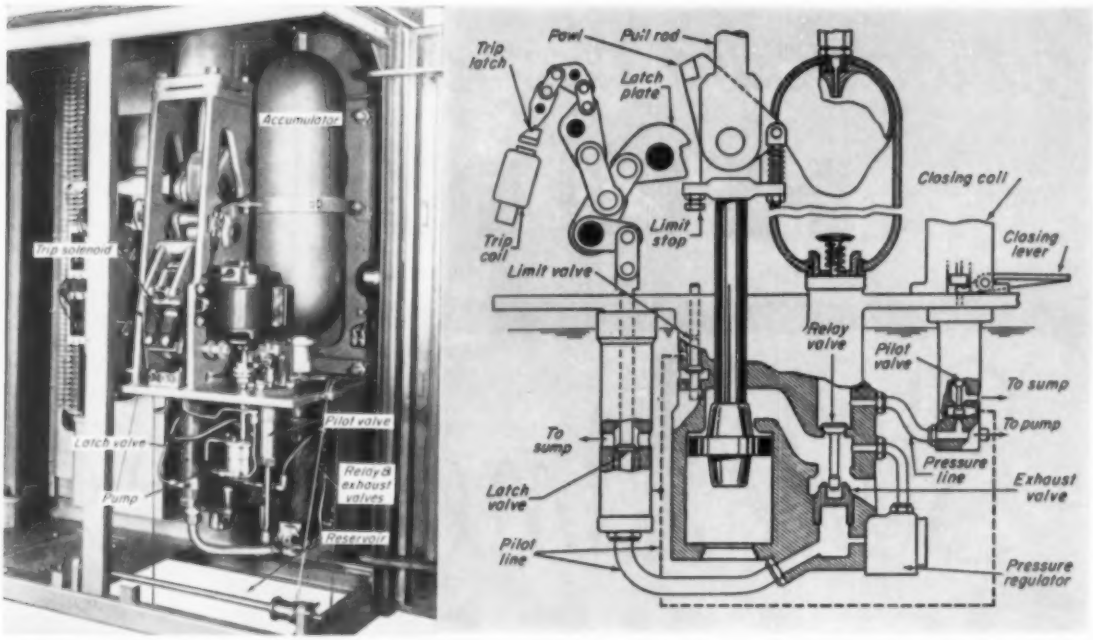


THE HYDRAULIC circuit-breaker-operating system. Cylinder, relay valve and exhaust valve are all built into a forged body. All units of the hydraulic circuit breaker are assembled on a mounting plate. When installed, pump, cylinder, and valves are immersed in the oil in the tank.

Accumulator and pressure regulator give constant output pressure

• By R. D. Hambrick, *Manager, Development Engineering, Federal Pacific Electric Co., San Francisco, Calif.*

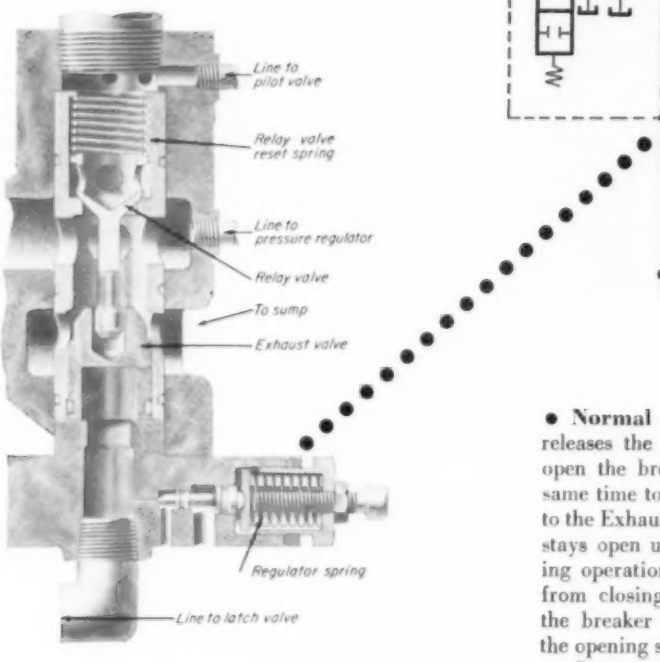
Hydropneumatic accumulators are a convenient way to store hydraulic power. But, as fluid is used, accumulator pressure drops. Where consistent operation is needed, large pressure changes just won't do. So, what's the answer when the job looks like a natural for an accumulator, but you can't put up with the pressure variation?

ALTHOUGH the byword of the electrical power industry is "do it better electrically", when it comes to operating the large circuit breakers that protect transmission lines from dangerous overloads, they use hydraulic power. Dependability, quick response, smooth, shock-free operation, and little ambient temperature effect are the reasons.

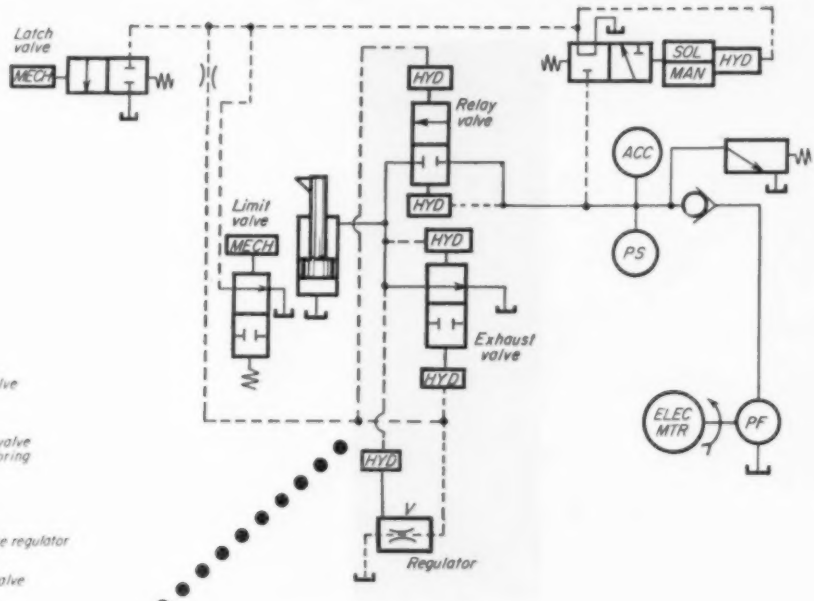
Perhaps the most often quoted reason for using an accumulator is: When you need quite a bit of oil but not very often, that's a job for an accumulator. A large, power circuit breaker hydraulic system is just about the perfect illustration of this. It may only have to work once a year. So, with an accumulator, a very small pump will make up the leakage and keep the accumulator charged. However, sometimes several operations in rapid succession are needed. This called for a circuit to keep pressure and, therefore, operating time constant despite the drop in accumulator pressure as the oil was used.

• **Operation**—With the circuit breaker open, energization of the closing coil, or a touch on the Manual Close lever, shifts the Pilot valve to apply pressure to the Relay valve, and the Exhaust valve, see circuit diagram. This closes the Exhaust valve and opens the Relay valve. Both the Latch valve and Limit valve are closed when the breaker is open.

With the Relay valve open, oil flows to the rod end of the piston to close the breaker contacts against the



SECTION THROUGH the Relay, Exhaust and Pressure regulator assembly. Poppet-type valves eliminate slow leakage when valves are closed.



opening spring force. Accumulator pressure applied to the Regulator controls the opening of the Regulator and thereby the pilot pressure applied to the Relay valve. This, in turn, controls the opening of the Relay valve and the pressure drop through the valve so a constant pressure of 1500 psi is applied to the piston, no matter what the value of accumulator pressure between 1500 and 2800 psi.

At the end of the closing stroke, the limit stop on the piston rod opens the Limit valve. This bleeds pressure from the Pilot valve so the spring closes it. Also, the Relay and Exhaust valves shift so the Relay valve is closed and the Exhaust valve opened. The piston rod is mechanically latched in the breaker-closed position. A boss on the blank end of the piston, which fits closely in an opening in the end of the cylinder, restricts the flow of oil out of the cylinder at the end of the stroke to decelerate and cushion piston movement and breaker contact closing.

• **Normal opening**—Tripping the latch solenoid releases the piston rod and lets the opening springs open the breaker. The Latch valve is opened at the same time to be sure that the line from the Pilot valve to the Exhaust valve is not pressurized. The Latch valve stays open until the trip latch resets during the opening operation. The Latch valve also stops the breaker from closing if the trip solenoid is energized while the breaker is closing. Piston construction cushions the opening stroke.

• **Construction**—All hydraulic circuit components are mounted on a plate and all units except the accumulator are immersed in the oil when the unit is assembled, see Figure 1. All the valves are poppet types to prevent leakage and loss of pressure during the long standby periods that may occur. All hydraulic seals are O-rings. No flat gaskets are used, even at pressure-free places like the tank-to-cover joint.

• **Why hydraulics**—High operating force requirement, smooth, shock-free motion, reliability, and consistent operation were the things that made the designers of these circuit breakers choose hydraulic operation. Particularly important was consistent operation over a fairly wide temperature range. This was attainable hydraulically to a higher degree than other means considered.

What a Circuit Breaker Does

A circuit breaker is a great big switch which operates to disconnect electrical power from the lines when they're overloaded by a short circuit, or fault. The fault might be caused by a lightning flash or falling tree limb during a storm. It has three sets of switch

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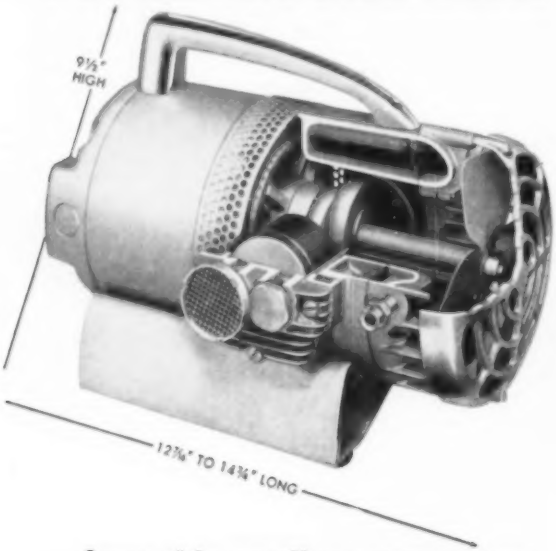

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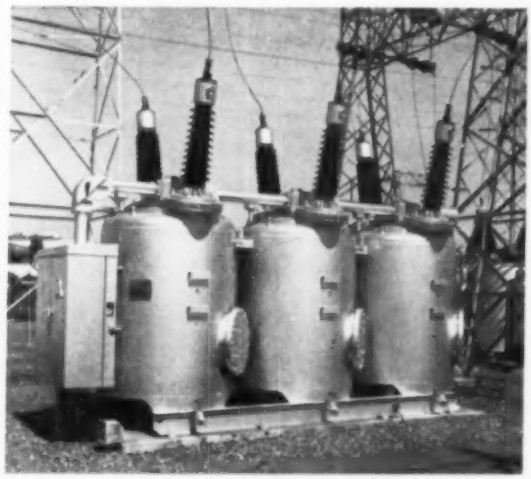
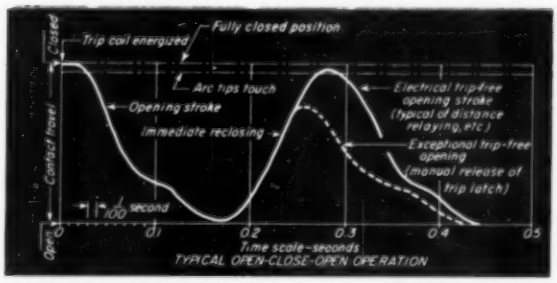
contacts. Each set is in an individual steel tank filled with oil. The operating mechanism is in a separate cabinet mounted on one of the tanks. When current in the lines rises above a safe value due to a fault, the



LARGE, 3-PHASE 115,000-VOLT circuit breaker with hydraulic operator.



CYCLE DIAGRAM for closing and opening times of a large, hydraulically-operated circuit breaker.

breaker must open in 1/20 sec or less. Typical line voltages are 34,500 to 340,000 volts.

Reclosing is automatically tried in less than 1/3 sec. Most faults clear before the first reclosure and as far as most power users are concerned, the whole process results in a slight flicker of the lights. In case the fault doesn't clear, the breaker will open again. As many as five trys at closing may be made before the breaker decides to stay open and wait until somebody finds the trouble and fixes it. Although the breaker is opened by springs and hydraulically closed, the hydraulic system must stop, reverse and close the breakers in about ¼ sec. This means moving several thousands pounds of parts at almost 20 feet per sec while compressing the opening springs. Electromagnetic forces also resist closing. The hydraulic mechanism does all this without shock, jar, or noise. ▼▼▼

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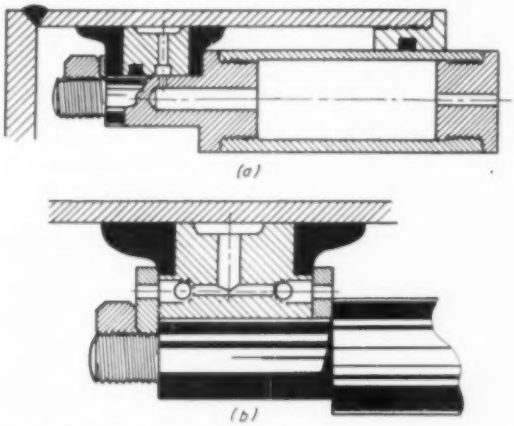


FIG. 1. Proper design relieves trapped oil pressure. Pressure can be vented to atmosphere or connected to the low pressure side of the piston.

Eliminate trapped oil to increase packing life

• By D. F. Turton, *Design Engineer, The Plessey Co. Ltd., England*

TRAPPED oil between packings can be relieved by proper design. Figure 1 shows two methods. The space between the packings can be vented to atmosphere, *a*; or this space can be connected to the low pressure side of the piston, *b*.

What if these design precautions are not taken? When two seals are mounted back-to-back in a double-acting cylinder, the pressure and action of trapped oil between packings can result in poor packing performance.

All seals leak a little, especially those of fabric reinforced rubber. They resist extrusion, but capillary action along the threads of the fabric carries oil past the seal. In time a pocket of oil forms. It is transferred from the back of one seal to the other, each time the piston reverses.

With the seal in a groove, Figure 2, trapped oil could force the lips against the wall. Full system pressure against the back of the seal packing will damage the lips.

A lantern ring, Fig. 3, can protect the packing against damage caused by trapped oil. Figure 3 shows what can happen when trapped oil pressure collapses the lips of the seal. Escaping oil prevents pressure buildup to a point where the packing could be damaged by being forced against the lantern ring. When assembled under no pressure, the heel of the U packing has clearance on both sides. This allows the lip to collapse inwards to release trapped oil.

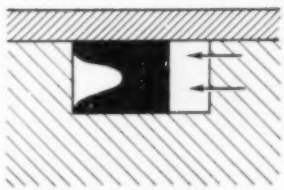


FIG. 2. Trapped oil can damage the sealing lips of this groove-inserted packing.

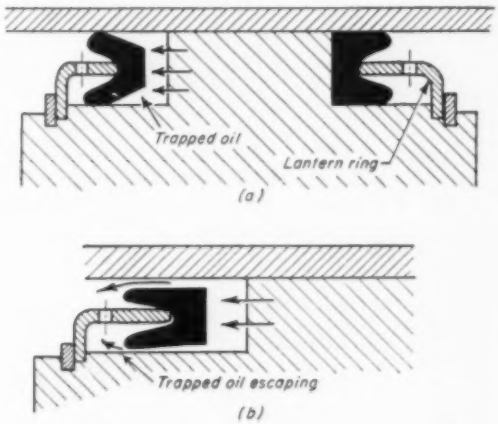


FIG. 3. Lantern ring design allows trapped oil to escape before damaging the sealing lips.

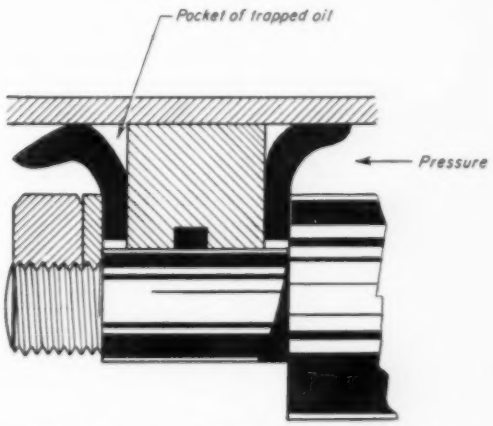


FIG. 4. Continuous flexing of the cup packing reduces sealing efficiency.

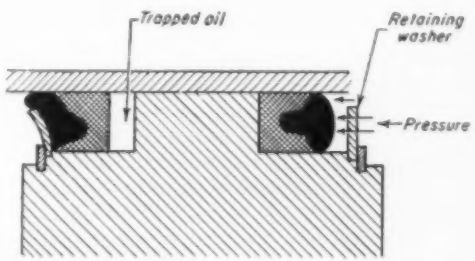


FIG. 5. Trapped oil can also damage this packing which has a soft rubber spreader ring.

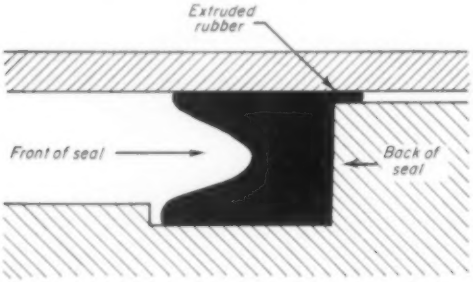
ELIMINATE TRAPPED OIL

Trapped-oil pressure can bend cup packings, Figure 4. As the piston reciprocates, one cup is bent by trapped oil while the other is pushed back toward its normal position. The continuous rubbing and bending leads to wear and failure.

A variation of the basic U packing, Figure 5, has the inside of the U filled with a soft rubber spreader. The spreader loads the sealing lips against the walls at low pressures and transfers the fluid pressure to the sealing lips at high pressure. Here again it's important to relieve the trapped oil, because it can force the soft rubber against the walls and prevent oil escape. Then full system pressure acting on the back of the packing, shortens the packing's life.

3 big reasons for packing wear

Extrusion: Rubber or other flexible packings tries to take the shape of any surface against which it is forced by hydraulic pressure. This can cause extrusion of the packing into the clearance between piston and cylinder. Rubbing quickly removes the

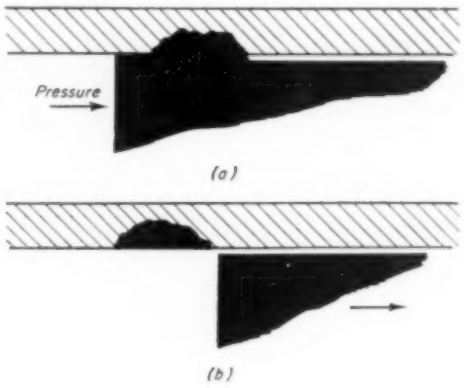


thin extruded lip and more rubber is extruded to take its place. The rate at which the heel corner of the packing wears away depends on the clearance and fluid pressure. The smaller the clearance and pressure, the slower the wear rate.

Heat: Wear rate increases as a packing becomes hard and brittle. The heat most likely to cause damage is generated by friction between the seal and cylinder wall. This local heating results in a brittle surface which wears off to expose another surface to this wearing action.

The lower the hydraulic pressure and surface speed, the less the heat and the lower the wear.

Surface finish: Fluid pressure forces the packing into imperfections in the cylinder wall. A rough surface can cut grooves along the length of the packing.



Once the groove is cut, "wire drawing" speeds packing breakdown. A jet of high velocity oil through the groove erodes the packing material. For long packing life, both the cylinder wall and packing surfaces should be smooth. Clearance should be less than .0025 in. Minimum surface finish should be 12 micro inches.

Why packings fail

1 Poor support at the packing shoulder.
Minimum clearance at back supporting ring reduces extrusion. A badly worn support ring should be removed. Back supporting rings should be flat for cup, flange and "U" packings.

2 Tight fit on inside support ring.
Unlike the back supporting ring, the inside ring requires clearance, and the corners should be broken with a slight radius to prevent cutting the inside shoulder of the packing.

3 Out-of-round cylinders or pistons.

4 Use of oversize packings to get a tight fit.
This will usually result in lip damage, destroying sealing ability. Sufficient space should be provided so that the lip does not touch the bottom of the cylinder.

5 Side strains on the piston.
Since eccentric loads can't always be avoided, the design should provide maximum guiding of the piston in the cylinders.

6 Using the packing as a bearing.

7 Dirt.
Install filters to remove contaminants which damage packings. Put wiper rings on exposed rods.

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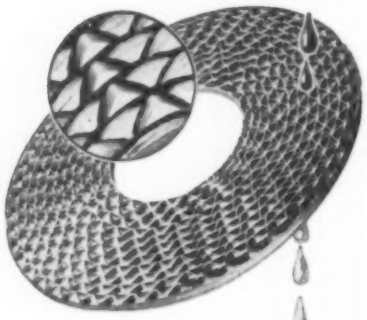

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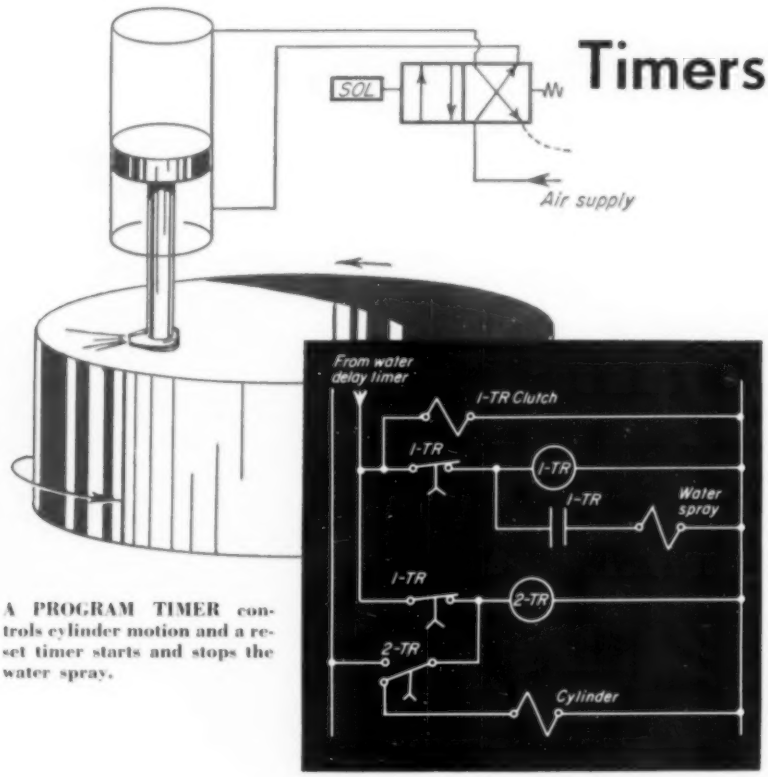
CIRCLE 51 ON TIME-SAVER CARD

Timers



A PROGRAM TIMER controls cylinder motion and a reset timer starts and stops the water spray.

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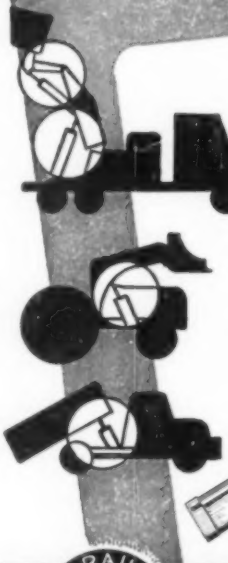

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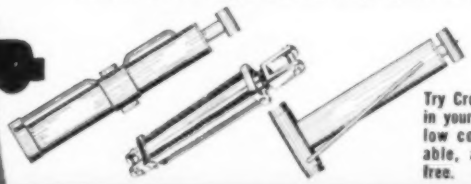

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CIRCLE 34 ON TIME-SAVER CARD

give air circuit a memory

• By M. G. Saake, *Ribble Engineering Co., Hackensack, N. J.*

IN MAKING sugar, centrifuges separate the syrup from the sucrose and then dry the sucrose. The first centrifuging slings the syrup from the sugar crystals. At this point the crystals are still coated with a thin layer of syrup, and they must be sprayed with water to wash off this coating. The sugar must be washed at just the right time, and must not be washed for too long or too short a time.

In one design, this washing is done by water sprayed from a nozzle on the rod end of an air cylinder. The cylinder reciprocates up and down for a preset number of cycles after the water spray starts.

An objective in designing the system was to have the cylinder return to its *up* position and stop at the end of the washing cycle, even though the water spray had stopped while the cylinder was still going down or coming up.

Two timers were arranged to control the water spray period and the up-and-down motion of the cylinder. A spring offset solenoid valve which is energized by a program timer controls the cylinder. The water spray is controlled by a reset timer.

• **Timed Sequence**—When timer 1-TR is actuated by a third timer (water delay) its clutch closes normally open contacts actuating the water spray solenoid valve. Timer 2-TR is also actuated through timed contacts of timer 1-TR. Program timer 2-TR then opens and closes its contacts as long as its motor is energized. This alternately opens and closes power to the solenoid valve controlling the cylinder.

When timer 1-TR times out, both its timed contacts open. If timer 2-TR contacts are still connecting power to its motor, it will continue to operate until its contacts switch. Thus it is always in the same position at the start of the cycle. The cylinder is then at the top of its stroke ready to move down as soon as the cycle is started. The solenoid valve controlling the cylinder is deactuated until timer 1-TR is reset (power disconnected from its clutch) and then energized from the water delay timer. ▼▼▼

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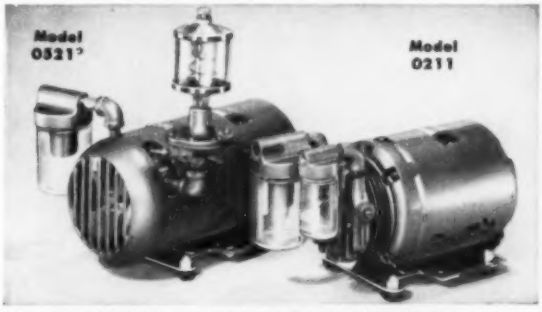

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CIRCLE 55 ON TIME-SAVER CARD

FIG. 1. THE TANK-MOUNTED bridge in carrying position, left, and being crossed by the launcher, right.

Hydraulics lets Army carry its own bridges

• By William R. Abell, *Chief, Fixed Bridge Test Section* and John K. Singleton, Jr., *Project Engineer*
Bridge and Marine Test Branch, U. S. Army Engineer Research and Development Laboratories Fort Belvoir, Va.

A 63-ft, 5-ton bridge is easily unfolded and put across a stream by one man and his gang of hydraulic cylinders. Hydraulics is ideal for this job requiring large forces far from the power source.

MOBILITY is an armored unit's greatest asset. But, mobility is lost when bridges must be thrown over a stream or gully. The ideal military bridge would be as mobile as the column, very quickly put in place and recovered.

The solution to this problem, worked out by the U. S. Army Engineer Research and Development Labs, is a folding aluminum bridge mounted on top of a turretless tank, Figure 1. The bridge can be quickly unfolded, placed in position, and then just as quickly restowed. Hydraulic cylinders powered by a pump driven by the tank engine "launch" the bridge.

• **Launcher operation**—First step in launching is to extend the HOLD-DOWN cylinder to release the clamping jaws. Figure 2 shows locations of the various hydraulic cylinders. This cylinder is controlled by the same valve as the OVERHEAD cylinder. Since the overhead cylinder is connected to the boom and must tilt the entire bridge from the horizontal travelling position to vertical, there is enough difference in the loads on the two cylinders to insure that the hold-down cylinder will operate first. When the hold-down cylinder has completed its stroke, the overhead cylinder raises the bridge.

Next step in the operation is extension of the SWING cylinder, mounted inside the boom. This swings the end of the bridge out away from the boom and in-

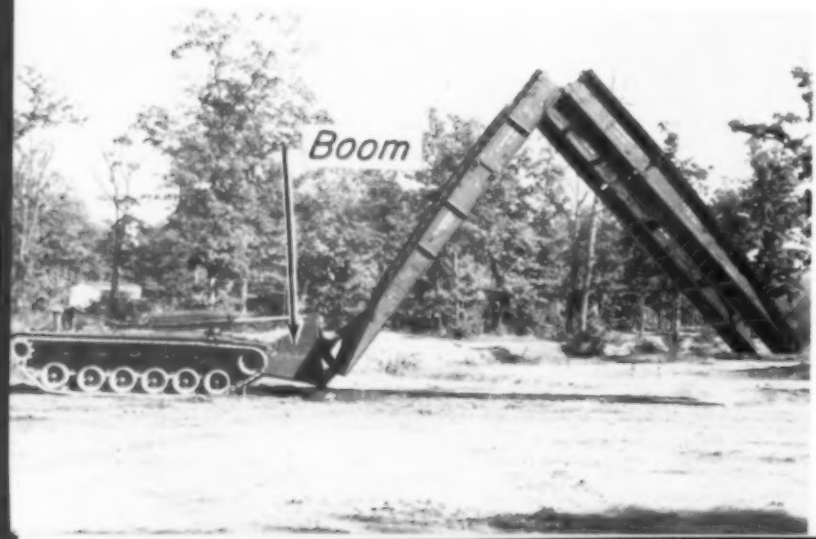

FIG. 2. LOCATIONS of most of the hydraulic cylinders can be seen in this view of the bridge being unfolded.

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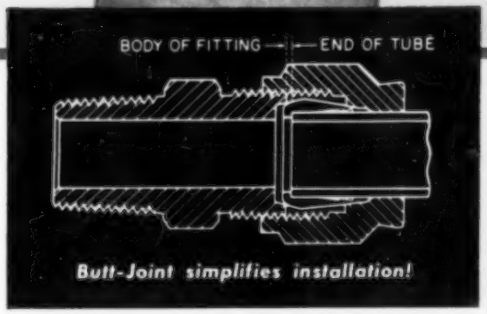
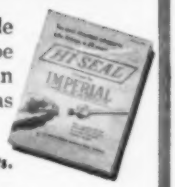
Tube doesn't enter the body of the fitting. It bottoms on shoulder of the sleeve. Camming action of the nut causes sleeve to form a collet-type triple-seal grip on the tubing.



Final circumferential seal is made by tapered edge of sleeve. No tube torqueing when making a joint. Can be disconnected and reconnected as often as desired.



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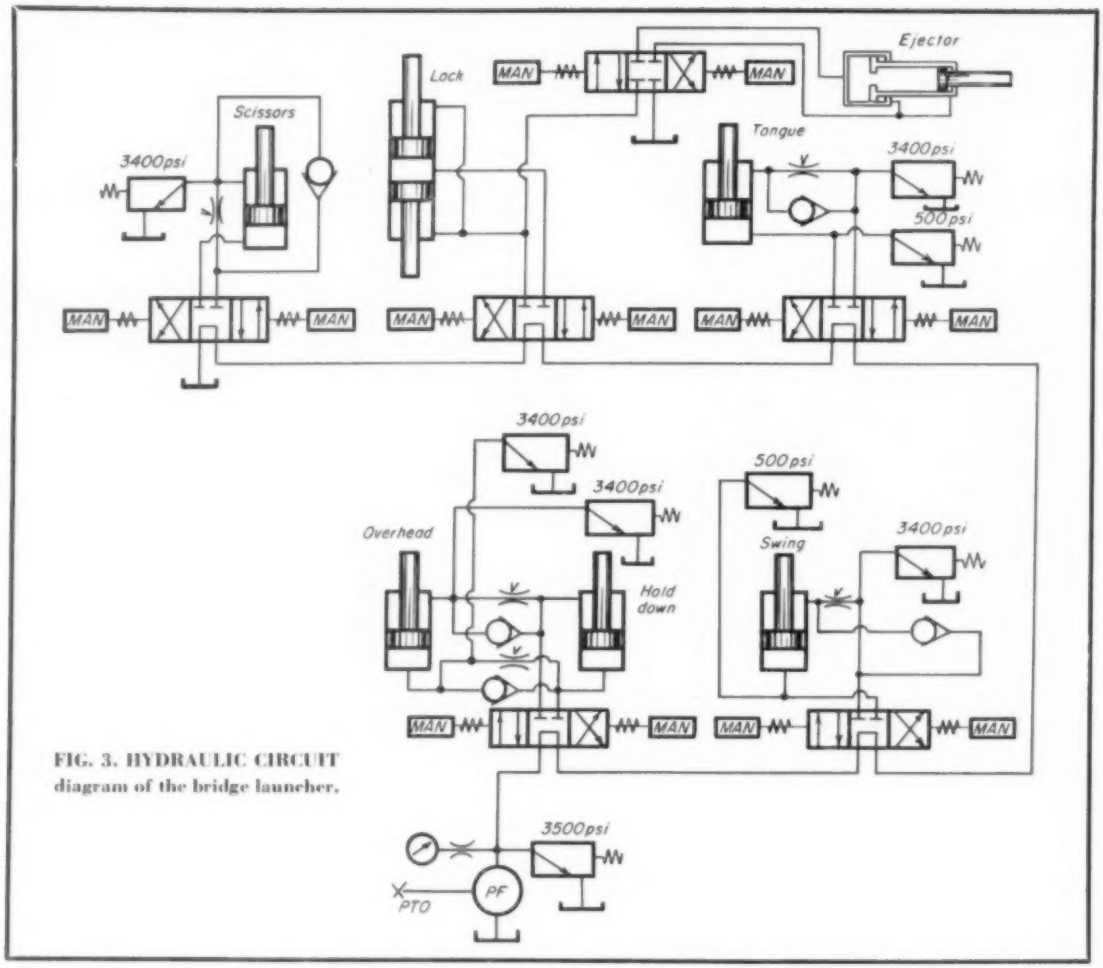

FIG. 3. HYDRAULIC CIRCUIT diagram of the bridge launcher.

creases the lever arm of the TONGUE cylinder. The tongue cylinder lowers the bridge from the vertical to the horizontal launched position. While the bridge is being lowered, it is also being unfolded by the SCISSORING cylinder. Because the weight of the bridge will extend the tongue cylinder, there is no pressure loss there and both cylinders—tongue and scissors—may be operated simultaneously.

With the bridge unfolded and lowered, it is ejected. A telescoping EJECTOR cylinder pushes the bridge away from the carrier. Self-sealing, quick-disconnect couplings are used in the lines to the scissors cylinder to allow this. The scissors cylinder is the only hydraulic component mounted on the bridge. All other components are mounted on the carrier.

The bridge is held to the tank by pins and eyes. The pins are rods of a tandem locking cylinder. As a safety measure, the hydraulic circuit is designed so the ejector cylinder cannot be moved in either direction unless pressure is applied to the lock cylinder to unlock. With no pressure applied to the lock cylinder, or with pressure applied in the lock direction, the ejector will not operate.

Hydraulic and mechanical connections from the tank to the bridge are duplicated at both ends of the bridge. Thus, the tank can cross the bridge and pick it up again from the other end.

• **Hydraulic system**—Circuit diagram of the bridge launcher hydraulic system is shown in Figure 3. With the exception of the ejector cylinder, all control valves are 3-position, 4-way tandem types. All valves are located in the tank operator's compartment. This lets driving, launching, and recovery all be done by one man.

The 31-gpm pump is driven from the 850-hp tank engine by a power takeoff through a mechanically-operated clutch. Relief valve setting of 3500 psi is based on required pressure of 3200 psi at the cylinders and allows for some line losses.

Relief valves connected to the various cylinders, protect the cylinders, valves, and structure from high pressures and shock which might occur when the tandem valves are closed. Flow control valves are used to meter oil out of the cylinders and control speed. The flow controls are also intended to limit speeds of parts which might fall in case of system failure. ▼▼▼

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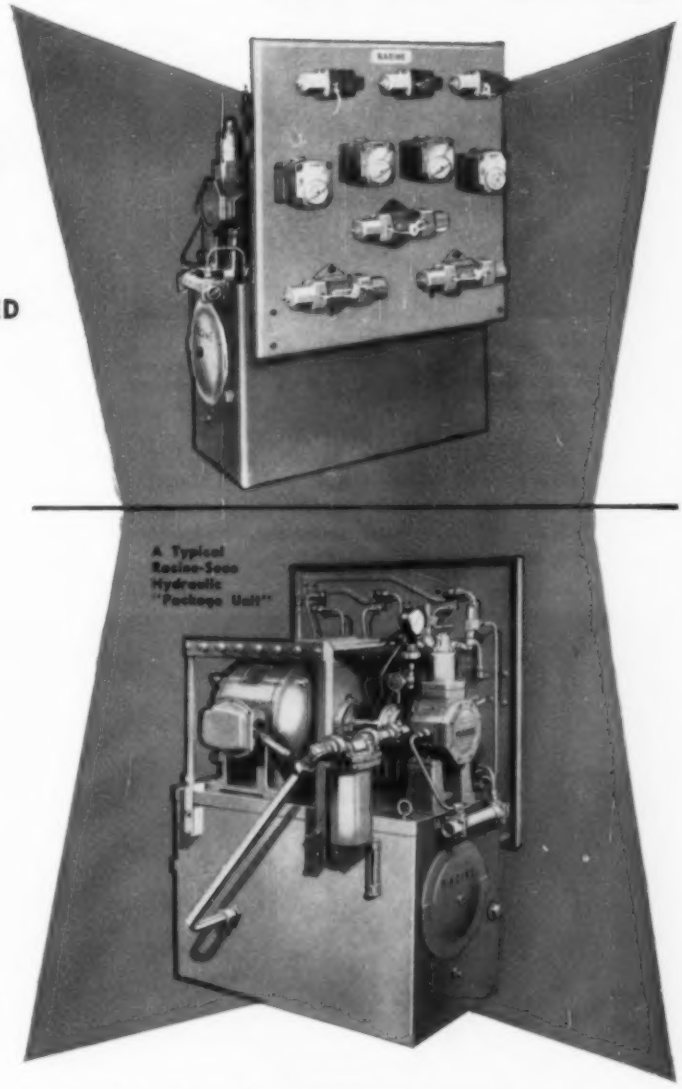

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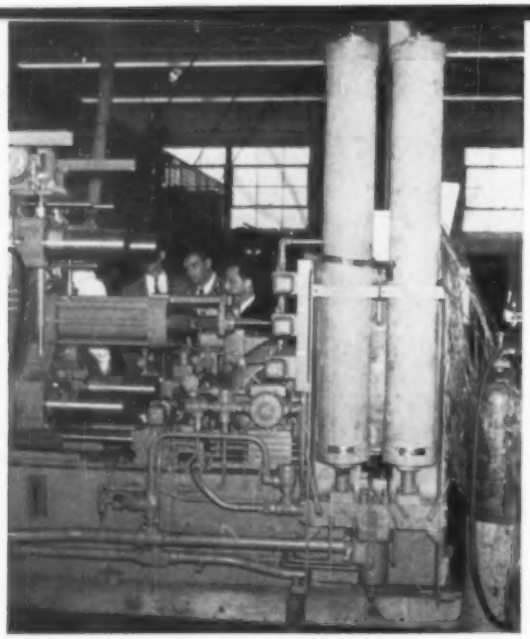


AUTOMATIC ACCUMULATOR shut-off is made by a large pilot check valve directly below the two piston type accumulators. Valve stops flow when the machine isn't operating.

Fluid power on die

LAST month AH&P editors met with Myron Malecki, chief engineer, and Jack Palmer, sales manager, at Cast-Master Inc. to learn about their techniques and ideas for fluid power systems.

● *As a leading die casting machine builder, what's your picture on the use of fire-resistant fluids?*

The customer tells us what fluid he wants to use. Today more than 95% of our machines are built to use a F-R fluid. We estimate that 60% of the companies buying our machines prefer the water-base fluid. Most of the others use a phosphate ester type.

Use of a F-R fluid doesn't present any design or construction problems for us. To the user it means considerably less pump life.

● *Since your machines use high priced fluids, have you given increased emphasis to leakage control?*

We've eliminated threaded connections. Except for the pump intake line, all lines 1-¼ inch or less are tubing with flared fittings. All larger sizes are flanged connections. Our design calls for rigid piping. Special telescopic fluid carrying tubes make it unnecessary to use swivel joints. We prefer the flared fitting because from our experience they withstand the shock conditions which occur during a die casting cycle.

● *Because of the large flow demand during the short shot interval, a die casting machine is a fine application for an accumulator. What types do you use?*

We use both the piston type and non-separator type. While it's less expensive, the direct gas to oil

casting machines

accumulator must be larger than the piston type to prevent intermingling, and to provide a reserve volume to prevent gas discharge.

● *Do you make your own cylinders?*

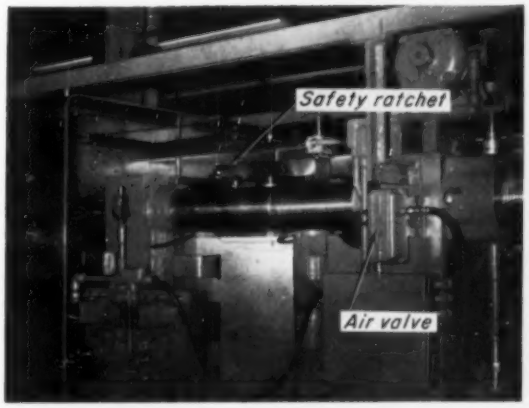
We purchase air cylinders; make our hydraulic cylinders. We've pretty much standardized on metallic rings on the piston and Vee rings on the rod. The cylinder bore is hardened to 60 Rockwell C and then honed. Die lock cylinders operate up to 2000 psi. An intensifier can give pressure up to 4000 psi at the shot cylinder.

● *How about making it easy for the machine user to check pressures?*

We do this on some machines by providing 3 or 4 check points with quick-connect fittings at which a pressure gauge is easily inserted and removed.

● *What precautions do you take to keep the system clean and at safe operating temperature?*

Proper selection of pump and valves, and good circuit layout come first. Reservoir capacity is made at least three times pump capacity. Suction filters are sized to handle four times pump capacity. Precautions are taken during machine assembly to keep the system clean and the system is flushed and drained before shipment. A water cooled heat exchanger is used to maintain temperature below 115F.



PNEUMATICS is used to operate one of the safety features. An air powered plunger locks in the safety ratchet to prevent closing of the press until the machine guard is completely closed.

● *What changes would you like to see made by the pump and valve manufacturer?*

We believe there's a need for sub-base, gasket mounted pumps which permit pump removal without disturbing piping.

Most valves today tend to be undersized. Full flow area on valves is needed. ▼▼▼

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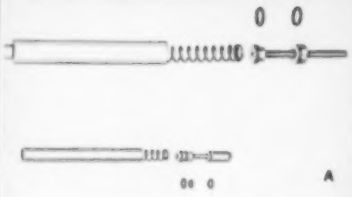

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Parco's pride in high quality manufacture and research means millions of Parco O-Rings help assure perfect performance in a million Mo-Bar cylinders . . . making Mo-Bar and Parco names to be trusted in the manufacture of hardware, food machinery, mobile equipment, miniatures . . . wherever perfect sealing is important. There is always a Parco Engineering Representative at your service . . . call him *before* your next problem on static and dynamic seals. No matter how critical the pressure or temperature range of your application, you will find Parco O-Rings promptly delivered from inventory or Parco custom-molded parts to be the best solution.

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NOVEMBER 1958

AVIATION SECTION

HIGH-PRESSURE PNEUMATICS 114
By Howard E. Wright

A comparison of weights of hydraulic and pneumatic systems for aircraft use. A definite weight advantage for the pneumatic system is shown in many cases.

HYDRAULICS HELPS OVERHAUL ENGINES 119

Hydraulic power moves large aircraft engines from vertical to horizontal to simplify overhaul and repair operations. Fluid power also rotates the engine about the prop shaft.

HYDRAULICS IN A SUPERSONIC WIND TUNNEL 120
By J. Grindrod

Hydraulic motors vary shape of a supersonic wind tunnel throat to control air velocity. Servo controls automatically select proper shape when Mach number selector is set.

AVIATION NEWS FROM THE FLUID POWER FIELD 124

AVIATION COMPONENT DATA 126

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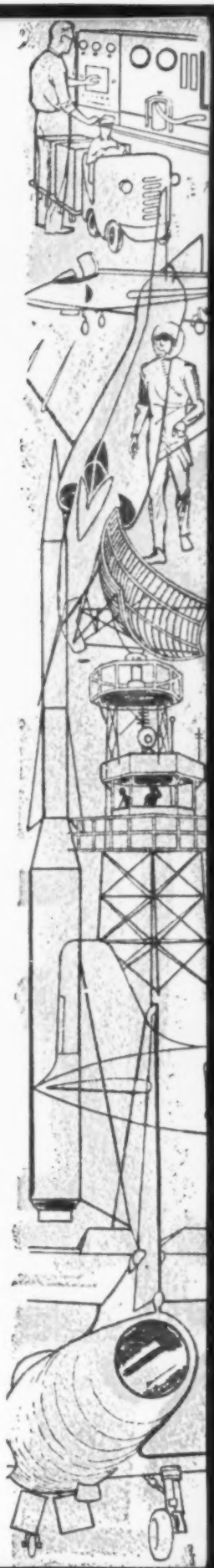


CIRCLE 104

High pressure pneumatics... can it

• By Howard E. Wright, *Assistant Project Engineer, Convair, A Division of General Dynamics Corp., San Diego, Calif.*

HIGH-PRESSURE air is dangerous. But so is low-pressure air. Whether it's an air bottle at 3000 psi, or a tire at 30 psi, a blowout has the same result—air escapes at the speed of sound, and some pieces go with the air. So, if a high-pressure air system is best, it should be used and the system designed to minimize the danger.

Because air is not harmed by nuclear radiation or high temperatures the way hydraulic fluids are, air may be the necessary fluid medium where high temperatures and radiation are met. The other, and perhaps most important thing for aircraft use, is the possible weight saving.

One development, which is still in the future and may reduce pneumatic system weight even more, is the closed system. Here, air will be returned to the compressor at about 1000 psi and boosted to 3000 to 5000 psi by the compressor. This kind of operation would improve compressor efficiency and thus reduce weight.

• **Comparing systems**—Figure 1 shows the basic elements. Each of the major parts—actuating cylinders, transmission lines, and energy source—will be considered separately.

• **Actuating cylinders**—Work outputs vs. the weights of 35 actual production cylinders are plotted in Figure 2. The cylinders were manufactured by several companies and included different designs. Maximum work is the product of stroke, piston area and operating pressure. Empty, or dry, pneumatic cylinders weigh more than dry hydraulic cylinders because they must be bigger than hydraulic cylinders which work at higher pressure. However, weight of the filled pneumatic cylinder is less than for the filled hydraulic cylinders because of the weight of the fluid. Operating pressure of 2000 psi was used to compute the plotted values for hydraulic cylinders because maximum horsepower output of a hydraulic system is gotten when pressure drop in the lines is 1/3 supply pressure. A pressure drop of 10% is assumed for the pneumatic system to give an operating pressure of 1350 psi. This value is reasonable because pneumatic lines are more efficient than hydraulic lines.

Horsepower output of hydraulic and pneumatic cylinders is compared in Figure 3. Pneumatic cylinders show a pronounced weight advantage at high horsepowers. At the lowest plotted values, there is little difference. This is to be expected because specific weights for both are infinite at zero power output and the plotted lines are converging.

• **Transmission lines**—Horsepower available from different sizes of tubing for various transmission distances is plotted in Figure 4. Again a pressure loss of 1000 psi in the tubing is assumed for the hydraulic system. Assumed pressure drop for the pneumatic line is 150 psi to give operating pressure of 1350 psi. This comparison is made at 0°F. Although not plotted here, pneumatic tubing is lighter at higher temperatures. However, the weight advantage is not as great. Although horsepower outputs of both pneumatic and hydraulic tubing are reduced by lowered temperature, the effect on the pneumatic tubing is much less than on the hydraulic.

Specific weight, or lb per hp, of hydraulic and pneumatic tubing vs. length of tubing is plotted in

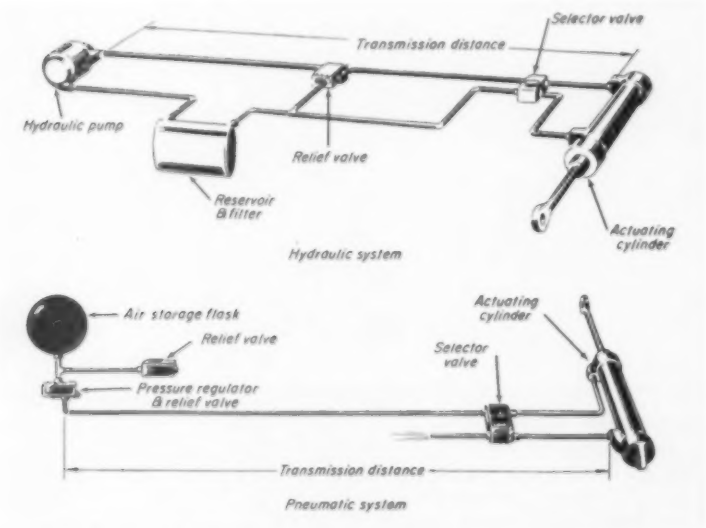


FIG. 1. WEIGHTS of the hydraulic and pneumatic systems shown here will be analyzed for various conditions. These systems are typical of today's aircraft systems.

replace hydraulics?

Figure 5. Tubing for 3000 psi is ⅛ hard stainless steel (MIL-T-6845). Tubing for 1500 psi is 61 ST aluminum (MIL-T-7081). Hydraulic system return line is the 61 ST. Weight of the hydraulic tubing increases about 35% when the temperature drops from 70 to 0 F, while there is little change for pneumatic tubing. All this means that pneumatic power transmission is very efficient. Weight of the pneumatic lines is about 1/10 that of the hydraulic lines and pressure drop is about 1/6 that of hydraulic lines.

• **Pressure sources**—To compare weights of a hydraulic pump and an air reservoir, or bottle, weight to provide a given horsepower for a certain time must be used. If you assume that the hydraulic pump is engine driven and that fuel needed to drive the pump is negligible, the pumping system weight is constant no matter how long the operating time. Specific weight of hydraulic pumps is plotted against horsepower supplied to the actuating cylinder in Figure 6.

Pumps from which the data for Figure 6 were gathered are pressure-compensated, variable-delivery types. These are the accepted standard for aircraft applications. Operating speed is assumed to be 3700 rpm. It is also assumed that these pumps are 92% efficient.

Figure 7 shows specific weights of air bottles to provide power for given lengths of time, at 0 F. Specific weights are lower at higher temperatures. These air bottles are spherical, glass fiber types. Both isothermal and adiabatic expansion were used to plot the lines in Figure 7. When the expansion time is short, that is one minute or less, expansion will be very nearly adiabatic. If expansion time is 30 minutes or more, expansion will be very close to isothermal. The glass fiber air bottles, although lighter than metal bottles, have low heat transfer coefficients and make isothermal expansion harder to get.

As Figure 7 shows, there is a slight gain when storage pressure is raised from 3000 to 5000 psi when expansion is adiabatic. There is a large gain with this pressure increase when expansion is isothermal. The change with temperature change is very slight.

Weight of stored air can be reduced considerably if tubular air frame members are used as the storage tanks. Some weight would have to be added to the air-frame to make the structural members air tight, but this weight would be much less than that of separate air bottles.

• **Systems**—Now that the three major portions of the system have been evaluated, the complete system can be measured. Figures 8 and 9 are a summation of the previous data plus an allowance for the weight of valves, fittings, hydraulic fluid tank, and hydraulic filter. For the pneumatic systems, this allowance is 10% of the weight of a system for 4 sec operation. For the hydraulic system, the allowance is 20% of the weight of a system for 1 sec operation. Conversion to other conditions is easy. In the case of a hydraulic system, all that's necessary is to add the difference in cylinder weight resulting from longer operating time, since the curves cover all the other possibilities.

For pneumatic systems, Figure 9 should be used as the starting point to find specific weights of differing systems. This is because

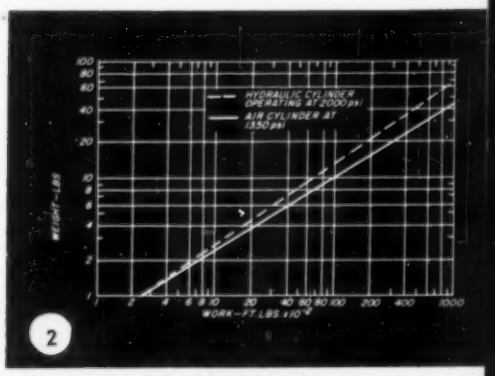


FIG. 2. WORK OUTPUT VS. WEIGHT of hydraulic and pneumatic cylinders. Hydraulic cylinders have a slight weight advantage if the weight of the fluid is not considered. When fluid weight is considered, the pneumatic cylinders show a definite weight advantage.

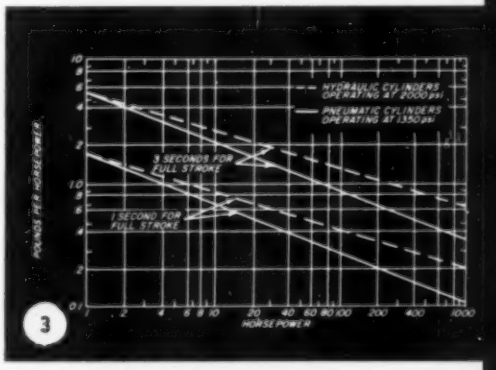


FIG. 3. PLOT of horsepower vs. specific weight of hydraulic and pneumatic cylinders shows that pneumatic cylinders weigh less, particularly at higher horsepower levels.

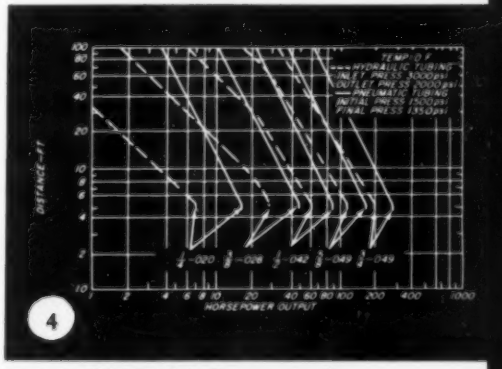
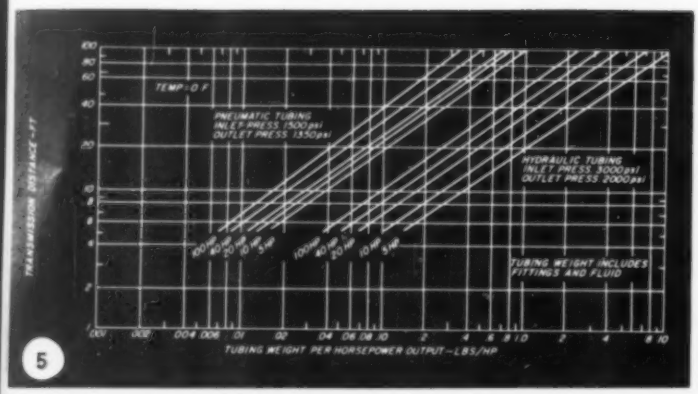
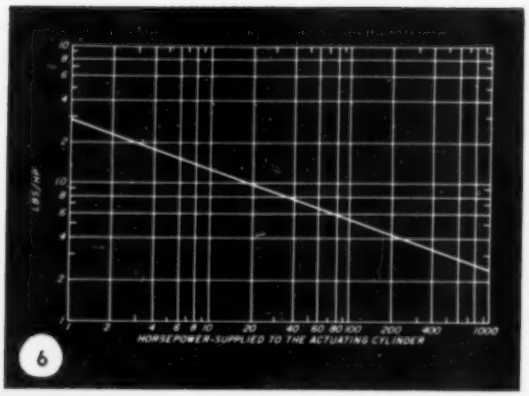
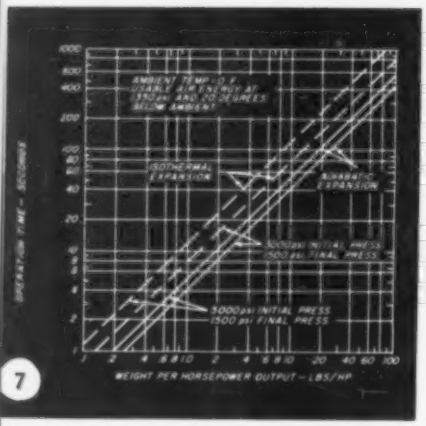
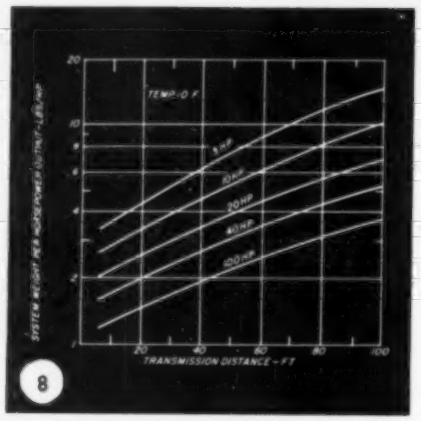


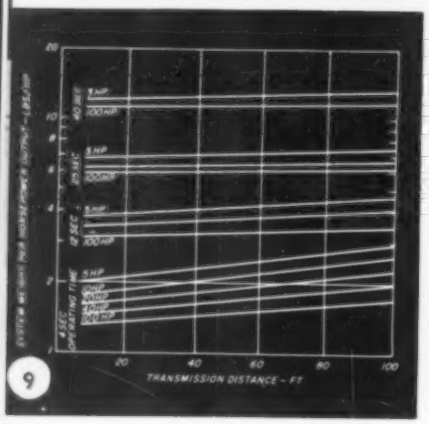
FIG. 4. HORSEPOWER transmitted vs. distance for different sizes of hydraulic and pneumatic tubing. Pneumatic tubing weighs less. The weight reduction is most pronounced at low temperature.











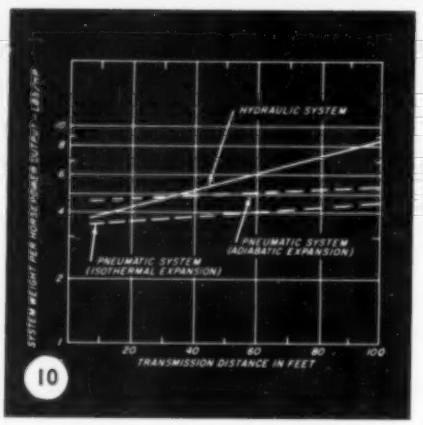


FIG. 5. SPECIFIC WEIGHTS of hydraulic and pneumatic tubing vs. transmission distance. Tubing weight includes fittings and fluids.

FIG. 6. SPECIFIC WEIGHT of hydraulic pumps vs. hp delivered to the actuating cylinder. These values do not change with time.

FIG. 7. AIR BOTTLE specific weights vs. operating times. This shows that air bottle weight increases with increasing horsepower and with increasing operating time.

FIG. 8. SPECIFIC WEIGHTS of complete hydraulic systems vs. transmission distance. These curves are based on an actuating cylinder rate of 1 sec for full stroke and include 20% of actuator, line and pump weight as an allowance for the weight of reservoir, filter, valves, hoses, and tubing brackets.

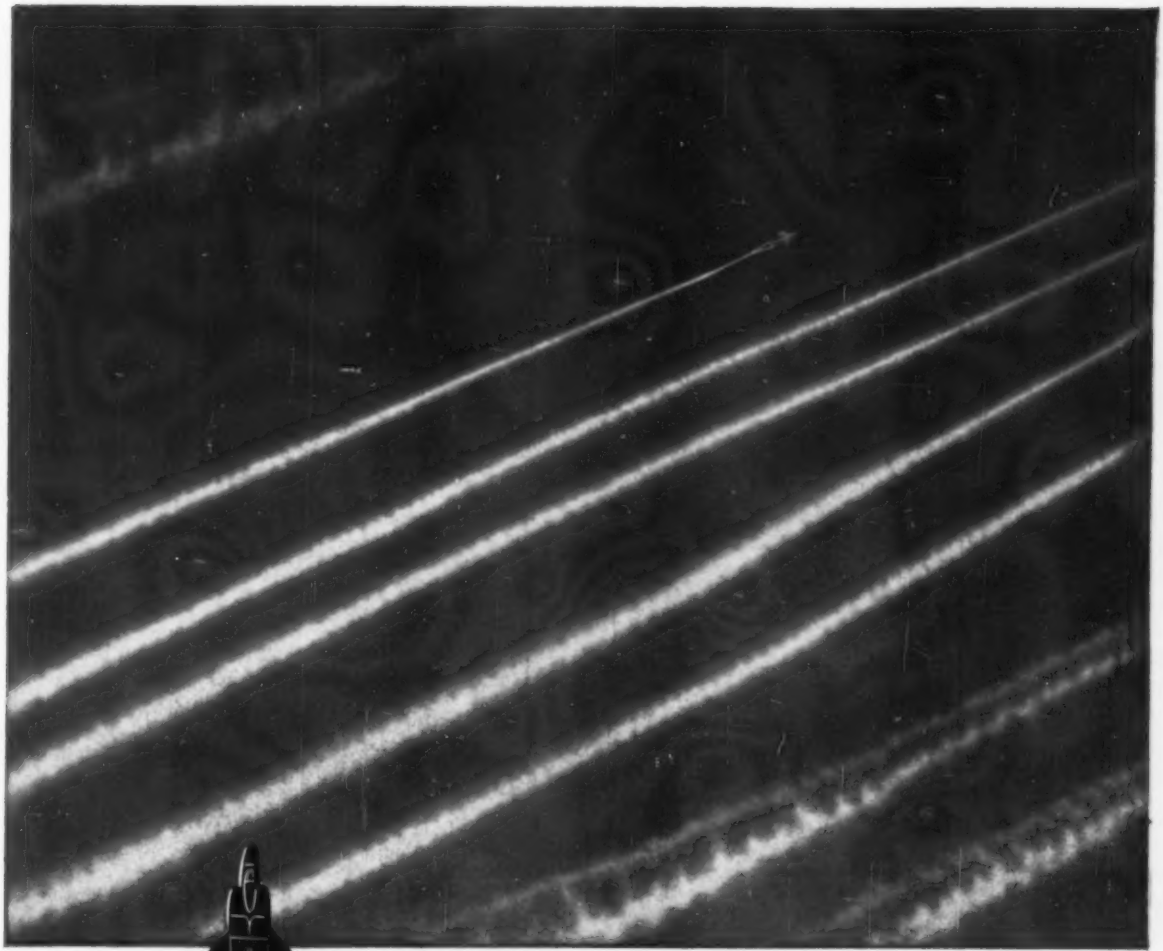
FIG. 9. SPECIFIC WEIGHTS of complete pneumatic systems vs. transmission distance. Conditions assumed are: Temperature = 0 F; Air storage pressure = 3000 psi; Adiabatic expansion in the air bottle; Actuating cylinder rate = 1 sec. Allowance for hoses, valves and tubing supports is 10% of the weight of a system for 4 sec operating time.

FIG. 10. SPECIFIC WEIGHTS of hydraulic and pneumatic systems to deliver 20 hp for four 3-sec actuations. Temperature is 0 F.

the fitting and valve allowance for these conditions is reasonably accurate for the distances and horsepowers plotted, no matter what other variations may be introduced. A change in operating time affects cylinder weight and air bottle weight. Therefore, the difference in cylinder weight and air bottle weight must be either added or subtracted. The new values are gotten from Figures 3 and 7. To demonstrate, the lower set of curves in Figure 9 give a value of 1.95 lb/hp for the system corresponding to the following condition:

Total operating time = 4 sec
No. of actuations = 4@ 1 sec ea.
Temperature = 0 F
Transmission distance = 60 ft
Air storage pressure = 3000 psi
Adiabatic expansion
Horsepower = 20

To convert this to the value for all conditions identical except number of actuations = 2 @ 2 sec each, go to Figure 3, find the value for 1 sec actuation = .53 lb/hp and add to get 2.48 lb/hp for these conditions. If all conditions were the same except total operating time = 8 sec because 8 cylinder actuations were necessary, Figure 7 shows that air flask specific weight is 2 lb/hp while air flask weight for 4 sec total operation is 1 lb/hp. Then 1 lb/hp must be added to give the corrected answer of 2.92



Aviation

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lb/hp. Similar conversions are made for other conditions.

Figure 10 shows the relative weights of pneumatic and hydraulic systems to deliver 20 hp at 0 F, where cylinder actuation time is 3 sec and total operating time is 12 sec. Storage pressure for the pneumatic system is assumed to be 3000 psi and both isothermal and adiabatic expansion are plotted. As Figure 10 shows, the high-pressure pneumatic system with isothermal expansion is lighter for all transmission distances. If expansion is adiabatic, a hydraulic system would be lighter for transmission distances of about 32 ft or less; the pneumatic system is lighter for longer distances.

This analysis has not considered many of the components such as pressure switches, quick disconnects for ground operation, pressure gages, and other items which go into a complete system. Before making a final selection the effect of these on system weight should be considered.

• **Compressors**—So far, there's been no mention of airborne compressors. The reason for this is that they are not particularly efficient and will usually increase system weight.

Present 3000 psi compressors with an output of 0.3 lb of air per min represent about 21 lb installed in an airplane. This includes air driers, tubing and hoses, but not the drive. Since the compressor could be engine driven, no allowance needs to be made for the drive. Whether or not this compressor should be used depends upon the system requirements and the usable operating time. An air bottle weighs 6 lb per lb of usable air. To equal this, the compressor must operate for 11.65 min. If the compressor can supply usable air for longer than this, it will save weight.

Compressors with higher outputs and more favorable weights are available today, but lack of experience with them keeps them out of this discussion. However, they should be investigated when a system is being designed. ▼▼▼

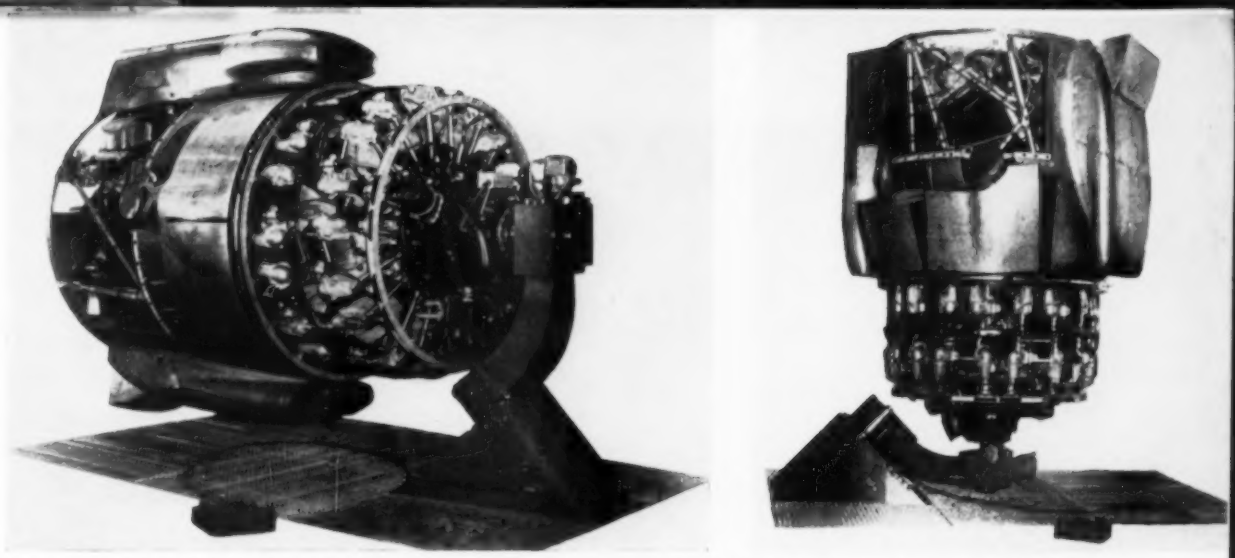


FIG. 1. HYDRAULICALLY-OPERATED aircraft engine overhaul stand shown with the engine in vertical and horizontal positions. Foot-operated controls can be seen here.

Hydraulics helps overhaul aircraft engines

LABELLED the Hydrosab, an engine overhaul stand recently developed by Ets. Edouard Baeyens of Brussels, Belgium, and SABENA, uses hydraulic power to position the engine quickly for disassembly, overhaul, or assembly operations. Engines are mounted by the propellor shaft. The entire engine may be rotated hydraulically from vertical to horizontal position, Figure 1. The engine may also be rotated about the prop shaft axis by a hydraulic motor. Special locks let the same motor turn the propellor shaft, crankshaft and other engine parts for valve and ignition timing.

The stand is designed for reciprocating engines such as the Pratt & Whitney R-1340, R-1830, R-2000, R-2800, and Wright R-1820 and R-3350. However, any reciprocating engine and most turboprop engines* can probably be mounted on the stand. The heaviest engine on this list weighs about 3500 lb. Hydraulics was chosen for this job because of its compactness and the smooth speed variation possible with a hydraulic motor and flow-control valve.

*Allison and Rolls-Royce have agreed the stand may be used with their turboprop engines on the Electra and Viscount.

• **Hydraulic system**—Circuit diagram of the hydraulic system is shown in Figure 2. A fixed-displacement pump supplies 2 Imperial gpm to the circuit. Pressure is limited to 700 psi by a relief valve. Pump output flows through two lines to a two-section valve. The valve has a 3-position, 2-way section and a 3-position, 4-way section. Both sections are operated by the same solenoids and springs.

Flow through the 2-way section is blocked whenever the 4-way section, which controls the hydraulic motor that rotates the engine around its axis is shifted. The 2-way section feeds another 3-position, 4-way valve that controls the oscillating motor or rotary torque actuator which turns the arm on which the engine is mounted. Only 180-deg rotation of the arm is required to turn the engine from horizontal to vertical.

The hydraulic motor for turning the engine is mounted at the end of the mounting arm. It drives the engine through a reduction gear set to give maximum speed of 3 rpm. Speed control is gotten with a throttling valve.

Control of the solenoid valves is by foot switches mounted together in a control box. The box connects to the stand by a length of cable so it can be moved where it is most convenient. ▼▼▼

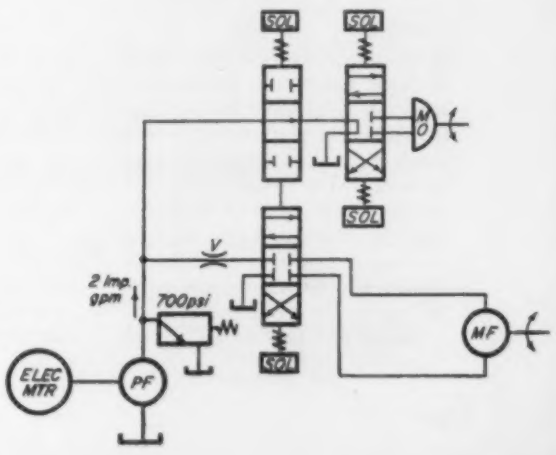
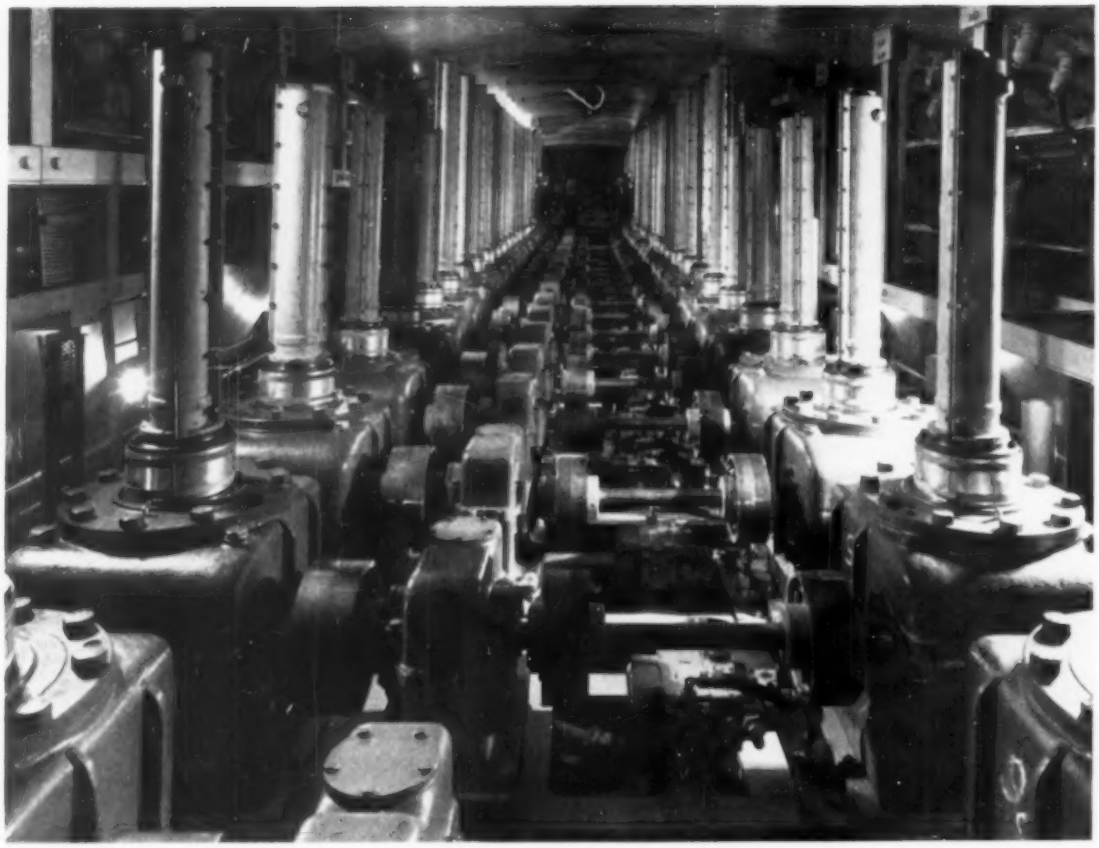


FIG. 2. HYDRAULIC CIRCUIT DIAGRAM of the engine overhaul stand.



THIS VIEW, below the floor of the supersonic wind tunnel test section shows screw jacks, hydraulic valves and gearing used to position the test section floor. Hydraulic motors are underneath the gear boxes connected to the right-angle screw-jack drives.

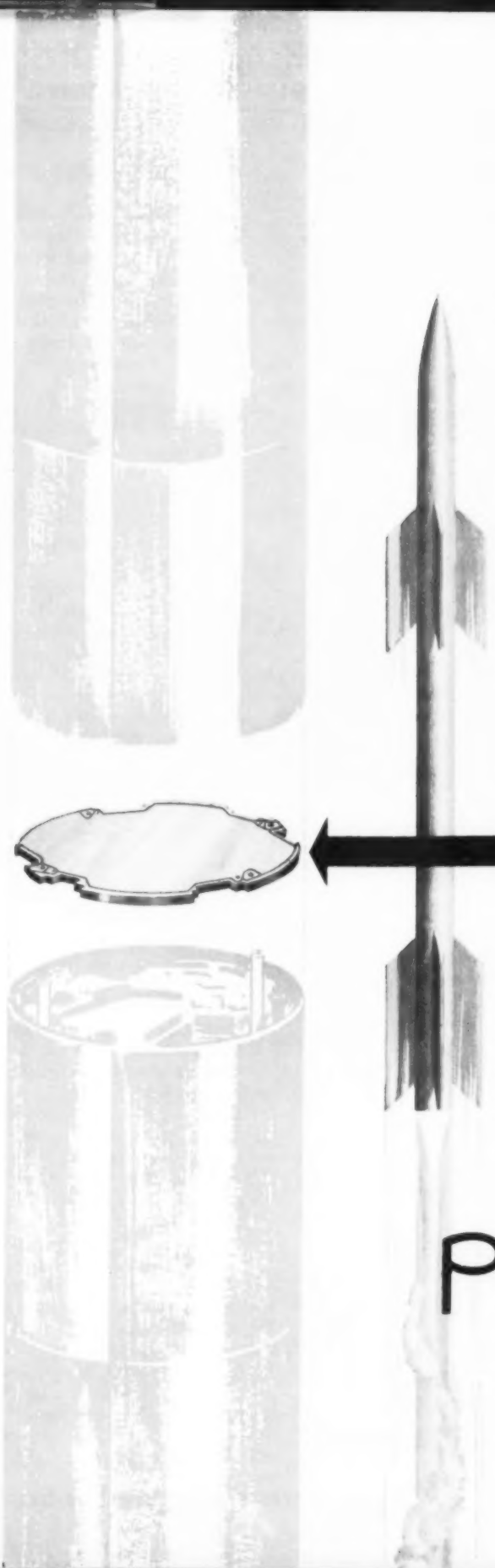
Hydraulics in a supersonic wind tunnel

• By J. Grindrod, *New Milton, England*

BRITAIN'S newest supersonic wind tunnel can produce air velocities up to Mach 2.8. Hydraulic equipment plays a big part in developing and regulating these air speeds. The tunnel is operated by the Royal Aircraft Establishment at Bedford, England. It is the biggest and most up-to-date in Britain and the most advanced of its type in Europe.

Technically, the tunnel is a variable-density, closed-circuit type. Test section is 8 by 8 ft. Models up to 6 ft in span can be tested. Physically, the tunnel has two 350-ft long legs joined by two 60-ft legs. Diameter varies from 20 ft at the compressor inlet to 47 ft at the tunnel cooler. The ten-stage axial compressor is driven by electric motors with a maximum output of 30,000 hp. Maximum compressor speed is 750 rpm.

• **Air speed control**—Changes in compressor speed can be used to regulate subsonic speeds, but supersonic speeds must be developed by regulating size and shape of a throat or nozzle section. The nozzle is usually 8 by 8 ft but the roof and floor of the nozzle section can be moved toward each other and flexed at the same time to produce the required size and shape for supersonic airflows. At the



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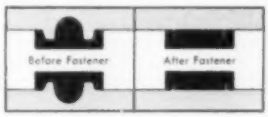

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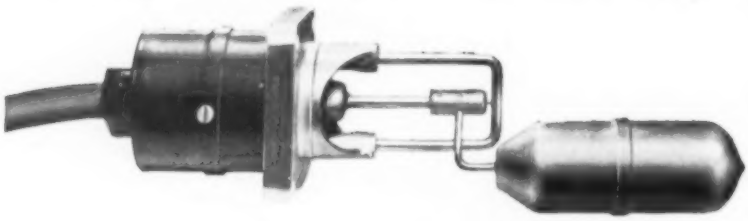

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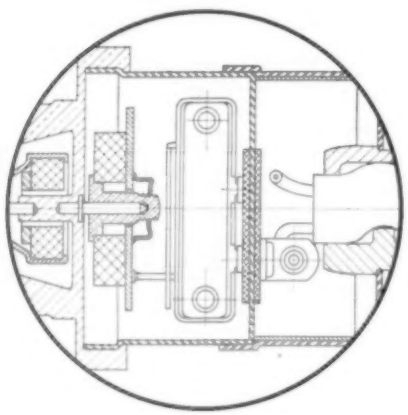

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AVIATION

highest velocity the opening is only 26 in.

Top and bottom of the nozzle are flexible steel plates. They are about 64 ft-9 in. long and weigh 12½ tons each. Thirty pairs of screw jacks, driven by hydraulic motors, are attached to the back of each plate to position it. Hydraulic servo valves controlled by a punched-tape system control the hydraulic motors and, therefore, the nozzle opening. Hydraulic oil pressure is 665 psi. All the operator has to do is select the wanted Mach number. The rest is automatic.

• **Diffuser**—After air passes through the test section, it is slowed down by a 60-ft.-long diffuser. Top and bottom walls of the diffuser section are fixed. The side walls are movable sections from 5 to 25 ft long. These walls are moved by screw jacks and hydraulic motors like those used in the nozzle. Control is by the same punched tape which sets the nozzle section. A total of 12 cylinders is used.

• **Other hydraulics**—Hydraulic motors are used to drive the test model mount to vary angles of incidence and roll. Angle of incidence can be varied from plus 22.5 to minus 22.5 deg. Roll can be varied through an angle of ±180 deg. Hydraulic cylinders are used to raise and lower the model on the trolley which brings it into the tunnel. A calibration probe which has 8-ft travel is also electro-hydraulically controlled.

The ten-stage compressor is made in two pieces. One section is four stages; the other is six stages. Only the four-stage piece is used for speeds below 1.6 times the speed of sound. The high-pressure section is removed and replaced with a dummy section. Dummy and high-pressure sections are mounted on wheeled trucks so that one or the other can be rolled into place. A hydraulic motor driving two screw jacks lifts the trucks onto their wheels when they are to be moved. The high-pressure section weighs 600 tons; the dummy section, 96 tons. ▼▼▼

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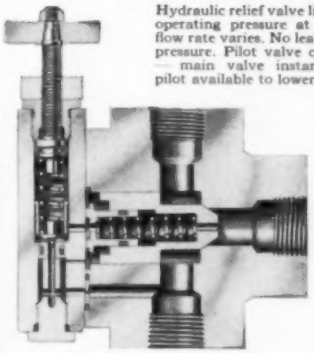
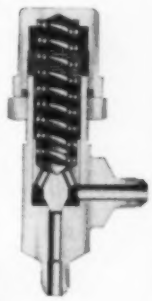


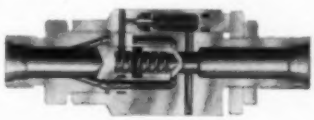
Hydraulic relief valve limits system's maximum operating pressure at constant level, though flow rate varies. No leakage loss below cracking pressure. Pilot valve controls pressure setting — main valve instantly conforms. Remote pilot available to lower setting of integral pilot control. 3 pressure ranges: 50 to 1200 psi; 1000 to 3000 psi; 2500 to 5000 psi. 50,000 tensile semi-steel body standard aluminum alloy to order. FMP or str. thread gasket seal bosses, ¼" to 1¼". Panel mounting bosses.

Modified units available as Sequence Operating Valves; and as Unloading Valves for clamping or other two-pressure applications.

POPPET TYPE RELIEF VALVE



Smoothly sliding poppet, seated by a stainless steel compression spring is the simple design of this rugged unit. External adjustment. Two types of sealing elements available. Soft seal poppets for air, gas, and liquids, with no leakage; stainless steel poppet for general hydraulic applications. Other poppet materials available for special chemical services. Eleven pressure ranges to 2750 psi, ⅛" to ¾" pipe, tubing, internal straight threading. 250°F std — specials to 400°F. Aluminum alloy, brass, or stainless steel.



ADJUSTABLE IN-LINE RELIEF VALVE

External relief adjustment without breaking line is the feature of this 5000 psi relief valve. Limits hydraulic system's maximum pressure at constant level, with minimum rise above cracking pressure. Turning locknut on body varies relief pressure adjustment spring in pilot valve. Free reverse flow. 2 pressure ranges: 50 to 2500 psi; 2000 to 5000 psi. Stainless steel body with hydraulic o-ring, -65° to 160°F standard. Packings for other fluids, and higher temperatures available. Flare or flareless tube connections ½" and ¾".

Distributors in principal cities coast to coast

CHECK RELIEF SELECTOR GLOBE NEEDLE PLUG

RM **REPUBLIC MANUFACTURING CO.**
15655 BROOKPARK ROAD • CLEVELAND 35, OHIO

CIRCLE 109 ON TIME-SAVER CARD

eliminates

a major cause of servo valve failure

New MF MICROWEB® FILTER

. . . cleans missile and aircraft hydraulic fluids of *all* particulate contaminants 0.45 micron and larger.

This is the new *process volume* form of the famous Millipore filter — a unique plastic screen with 50 million precisely dimensioned pores per sq. cm. of surface area, with 100% cut-off at 0.45 micron.

MF Microweb filters are now being used to clean hydraulic fluids (1) before storage in tanks (2) on fill/flush/bleed stands both during missile manufacture and field testing and (3) by component manufacturers for flush cleaning and filling. They are also in use filtering critical lubricating oils, ultrasonic cleaning fluids, process air and gases — wherever close-tolerance clarity is essential.

Microweb apparatus, including stainless steel filter holders, can be supplied in standard and special designs.

Millipore

NEW STANDARD OF PRECISION IN MICROFILTRATION

SEND FOR DETAILS — clip this coupon — attach it to your letterhead — sign your name — and mail to —

MILLIPORE FILTER CORP.
Dept. AH, Bedford, Mass.

CIRCLE 89 ON TIME-SAVER CARD

AVIATION NEWS

from the fluid power field

R. R. Muller has been named general manager of the **Aeronautical Division of Flexonics Corp.**, Maywood, Ill. Muller gives up his duties as treasurer of Flexonics to head up all company activity in the aircraft, rocket, and missile field.

A new illustrated, 4-page brochure in color describing pneumatic vibration isolation systems has been released by **Walter Kidde & Co.**, Belleville, N. J. Systems are designed to protect delicate missile controls, aircraft components, and sled test instruments subjected to rapid g load changes.

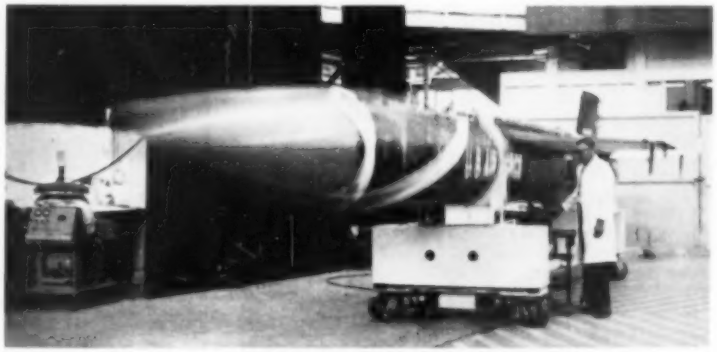
Impulse test standards for high pressure, high temperature aircraft hose have been raised to 250,000 cycles by **Resistoflex Corp.**, Roseland, N. J. for its Teflon assemblies. This upgrading of standard ratings more than doubles the usual industry test of 100,000 cycles for 3000 psi at 400 F.

WEATHERHEAD HAS NEW AVIATION AND MISSILE GROUP

The Weatherhead Company has formed an aviation and missile group. Plants are in Cleveland, Ohio, Glendale, Calif., and Orange, N. J. Each has its own engineering, manufacturing, and sales organizations. **S. C. Howell** moves from the Cleveland plant to be general manager in Glendale where precision fittings and valves will be made. General manager in Cleveland is **Albert J. Weatherhead III.** This plant will concentrate on valve production items.

In Orange, N. J., the Eastern Aircraft Products Corp. specializes in quick-disconnect couplings and special valves. **Louis B. Courtot,** formally chief engineer of special products, will coordinate engineering of the new group.

BOMARC BRONCO . . .



. . . is the name of this device developed by *Boeing Airplane Co.* for testing the guidance system of the IM-99 missile. It bumps, bucks, sways, and rolls the missile through a 2½-min simulated flight to check out the guidance system which corrects for roll, pitch, and yaw in flight. Missile is mounted on four air springs which utilize the natural bounciness of trapped air.

Victor Regulators control high pressure gases...safely and accurately

GD700 SERIES for testing pneumatic components or operating gas systems. Gas-O-Dome primary regulator is controlled by a relief venting, high pressure, spring loaded regulator. This combination offers you precise regulation for both low or high volume applications.

MODEL	PSI MAX. INLET	PSI OUTLET RANGE	GAUGES (integral or panel mounting)
GD710	7000	400-7000	10,000-10,000
GD711	7000	200-3600	10,000- 5,000
GD712	7000	200-2000	10,000- 4,000
GD713	7000	50- 800	10,000- 1,000
GD714	7000	10- 150	10,000- 200
GD700	3600	200-3600	5,000- 5,000
GD701	3600	200-2000	5,000- 4,000
GD702	3600	50- 800	5,000- 1,000
GD703	3600	10- 150	5,000- 200

Flow: Approx. 300 scfm. Leakage: None.
Operating temp. range: −67° F to +200° F (Storage −80° F)

LR SERIES Loading Regulators for "dead end" and low capacity testing (2 sfcm.) of pneumatic components, or for operating gas systems. Will hold dead-end pressures without leakage—also will hold supply pressure even when inlet pressure decreases.

MODEL	PSI MAX. INLET	PSI OUTLET RANGE
LR20B	7000	40-7000
LR19B	7000	20-3600
LR18B	7000	15-2000
LR17B	7000	10- 800
LR16B	7000	5- 200

Operating Temp. Range: −67° F to +200° F (Storage −80° F)
Leakage: None.

BOTH GD700 AND LR SERIES are field proved. They regulate all non-corrosive gases, including oxygen. Forged bronze bodies; stainless steel trim; Kel-F seats; internal filters; built-in adjustable relief. Proof pressure 2 times rated pressure; burst pressure 3 times rated pressure. Panel mounting. Stainless steel models available for corrosive gases. For complete specifications, write us today.

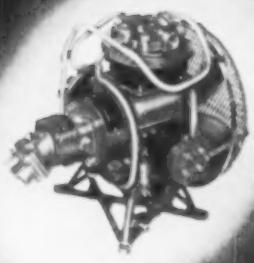
VICTOR for welding

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment; high pressure and large volume gas regulators; hardfacing rods, blasting nozzles; cobalt & tungsten castings; straightline and shape cutting machines.

844 Folsom St., San Francisco 7 • 3821 Santa Fe Avenue, Los Angeles 58 • 1145 E. 76th St., Chicago 19
J. C. Menzies & Co., Wholly-Owned Subsidiary

AIR COMPRESSORS



By
M.C. MFG. CO.

a leader in the development and manufacture of dependable, lightweight, hydraulic, pneumatic and fuel components

The picture above shows the
MC 2004-20 UNIT-AIR COMPRESSOR
For Airborne Pneumatic Systems

Characteristics

TYPE:	4-Stage, 4-Cylinder
PRESSURE:	3800 PSI
CAPACITY:	2 SCFM
INLET:	Can Be Pressurized
BEARINGS:	Anti-Friction Type
LUBRICATION:	By Splash
LUBRICANT:	MIL-L-6085 Oil
OIL CAPACITY:	Sufficient for 100 Hrs.
COOLING:	Integral Fan
DRIVE:	Hydraulic Motor, 1.6 GPM, 2500 PSI
WEIGHT:	(Less Motor) 11.87 Lbs.

Other Precision Products

VALVES OF ALL TYPES: Brake • Control • Manual • Pressure Reducing • Relief • Restrictor • Shuttle • Solenoid • Special • Transfer

ALSO Air Compressors • Dehydrators • Fuel Pumps

M. C. MANUFACTURING CO.
Mail: P.O. Box 126
Plant: 116 Indianwood Road
LAKE ORION, MICHIGAN
WEST COAST OFFICE
716 Wilshire Blvd., Santa Monica, Calif.

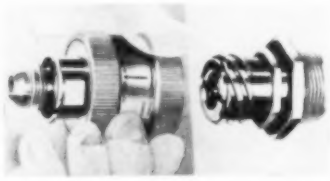
Representatives:
D. & O. ENGINEERING CO.
P.O. Box 3107, Wichita, Kansas
F. C. MINCH
1132 Donson Drive, Dayton 10, Ohio

CIRCLE 86 ON TIME-SAVER CARD

AVIATION COMPONENT DATA

Self-Sealing Coupling
. . . gives positive lock

Designed for 3000-psi hydraulic systems to meet MIL-C-25427 specs. Designated the 3200 series it connects with a quarter turn of the

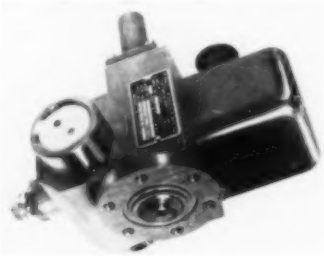


locking nut and disconnects with a straight pull on the nut. Designed to prevent partial connection, a touch or a glance tells whether the coupling is connected and locked. No fluid loss when disconnected.—*Aeroquip Corp., Jackson, Mich.*

CIRCLE 500 ON TIME-SAVER CARD

Electro-Hydraulic Servo System
. . . anticipates velocity

Servo gives an output velocity proportional to the input and time derivative of the input electrical command. The derivative computa-



tion is generated by means of hydromechanical rate-feedback network which measures and feeds actuator velocity back to the servo flapper which gives velocity anticipation.—*Hydraulic Research & Mfg. Co., Burbank, Calif.*

CIRCLE 501 ON TIME-SAVER CARD

Instruments

A technical brochure on gage, absolute, and differential-pressure measurements describes the performance, application, and specifications of a line of strain gage pressure transducers. Also included are circuit diagrams and a typical installation. *Gulton Industries, Inc., Metuchen, N. J.*

CIRCLE 502 ON TIME-SAVER CARD

Calculator
. . . for fluid flow

Six-inch dia double-faced made of vinyl plastic. Gives fast readings of flow, pressure drop, and orifice sizing for both air and liquids, with

accuracy of 15-in. linear slide rule. Calculator's three dials can be set and readings taken direct without any calculations required. Price $3.75. Available from—*Eckel Valve Co., San Fernando, Calif.*

CIRCLE 503 ON TIME-SAVER CARD

Synthetic Hydraulic Fluid
. . . for temperatures to 700 F

QF-6-7009 fluid is thermally stable in closed systems from −25 to 550 F for long periods and to 700 F for short periods. Fluid is one of a series of experimental alkyl silanes, and is available in development quantities.—*Dow Corning Corp., Midland, Mich.*

CIRCLE 504 ON TIME-SAVER CARD

Hydraulic Servovalve
. . . features reliability

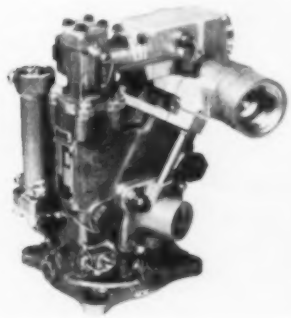
Model 410 miniature servovalve can pass particles up to 200 microns in the first and second stage without causing trouble. It has a frictionless high-gain, push-pull, force-feedback

servo that controls the second stage. Its dry torque motor is hermetically sealed. Flow ranges from ½ to 5 gpm with 1000 psi pressure drop. Operating pressures 300 to 3000 psi. Weight 11 oz.—*Raymond Atchley, Inc., Los Angeles, Calif.*

CIRCLE 505 ON TIME-SAVER CARD

Variable-Delivery Pump
. . . is torque limiting

Designed for ram air turbine applications the unit can deliver 3000 psi outlet pressure at all turbine speeds and limits pump torque demand to that which the turbine can



deliver at any particular speed. It automatically reduces operating pressure when a high flow rate is required at low turbine speed. It weighs 11.8 lbs and delivers 12.2 gpm at 3000 psi and 8000 rpm.—*Vickers Inc., Div. of Sperry Rand Corp., Detroit, Mich.*

CIRCLE 506 ON TIME-SAVER CARD

Continued on next page

Use Chemiseal® NYLON PRESSURE TUBING

outperforms metal

STRONG Types for 1000 psi and 2500 psi.

FLEXIBLE Saves flexible couplings, and intermediate fittings.

DURABLE Exceptionally high resistance to flex and vibrational fatigue. Resists abrasion and impact.

ECONOMICAL Outperforms metal at a fraction of the cost. Saves installation labor.

ADAPTABLE Sizes from ⅛" to ½" O.D. —useable with any standard metallic flare or compression fittings.

SERVICEABLE At temperatures ranging from −100°F to +225°F. Unaffected by hydraulic fluids, oils, alkalies, most solvents.

For prompt service, contact one of The Garlock Packing Company's 30 sales offices and warehouses throughout the U.S. and Canada, or write for further information.

United States Gasket Co., Camden 1, N. J.

® U.S.G. Trademark

United States Gasket *Plastics Division of* GARLOCK

CIRCLE 131 ON TIME-SAVER CARD

AVIATION COMPONENT DATA

Missile and Rocket Valves

A specification manual gives data on high-pressure hydraulic and pneumatic valves. Included are dimension drawings, flow charts, and test specifications on 48 types of solenoid valves including normally open or closed, 2, 3, & 4-way. Made in stainless steel and aluminum for pressures to 3000 psi. Available from *Skyvalve, Inc., Syracuse, N. Y.*

CIRCLE 507 ON TIME-SAVER CARD

Brazed Tube Connectors

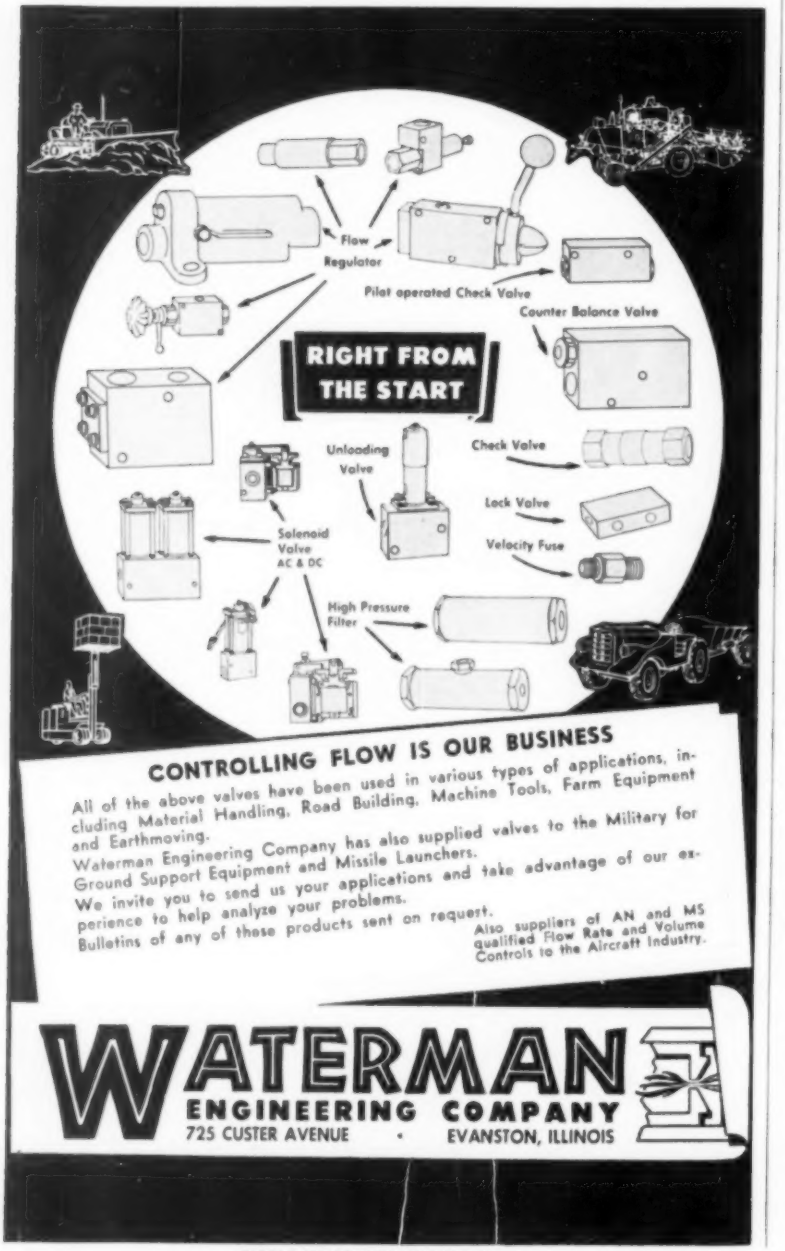
. . . for aircraft and missiles

Suitable for close quarters where wrenches can't be used. Fitting has a pre-positioned silver alloy brazing ring. Requires only insertion of tubing and applying heat. Torch, induction coil or resistance heating can be used. Socket of fitting aligns tube.

Made in all body shapes from 1/4 to 2-in. OD in steel, stainless steel,

naval brass, and cupronickle. Joint strengths to 130,000 psi in tension and 48,000 psi in shear. Not effected by vibration.—*Parker Fittings & Hose Div., Parker-Hannifin Corp., Cleveland, Ohio.*

CIRCLE 508 ON TIME-SAVER CARD


RIGHT FROM THE START
Flow Regulator
Pilot operated Check Valve
Counter Balance Valve
Unloading Valve
Check Valve
Lock Valve
Velocity Fuse
Solenoid Valve AC & DC
High Pressure Filter
CONTROLLING FLOW IS OUR BUSINESS
All of the above valves have been used in various types of applications, including Material Handling, Road Building, Machine Tools, Farm Equipment and Earthmoving.
Waterman Engineering Company has also supplied valves to the Military for Ground Support Equipment and Missile Launchers.
We invite you to send us your applications and take advantage of our experience to help analyze your problems.
Bulletins of any of these products sent on request.
Also suppliers of AN and MS qualified Flow Rate and Volume Controls to the Aircraft Industry.
WATERMAN
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725 CUSTER AVENUE • EVANSTON, ILLINOIS

CIRCLE 139 ON TIME-SAVER CARD

Teflon Hose Assemblies

Aeronautical synthetic and Teflon hose assemblies, and fittings is the theme of a 16-page catalog. Specification tables show military part numbers, dimensions, performance standards, and installation data. Catalog, thumb-indexed with product types and their military part numbers is published by *Flexonics Corp., Maywood, Ill.*

CIRCLE 509 ON TIME-SAVER CARD

Air Compressor & Vacuum Pump

. . . powered by single ac motor

Model RG-18130 has a double-ended motor driving an oil-free reciprocating air compressor and an oil-wetted rotary vacuum pump. It was built for pre-flight test of

missiles or aircraft instruments. The compressor will deliver 450 cipm of free air at 30 psi. The vacuum pump will draw 0.2 in. Hg abs, or 600 cipm flow with 10 in. Hg abs inlet pressure. Unit will operate in ambient temperatures from −65 to 140 F.—*Lear Inc., Lear-Romec Div., Elyria, Ohio.*

CIRCLE 510 ON TIME-SAVER CARD

Highlights of SAE Aircraft Committees' Fall Meeting—September 22-26

FUTURE TRENDS IN MISSILE AND AIRCRAFT SYSTEMS . . . was subject of a symposium. Four papers covered problems to be solved to keep up with aircraft performance. Indication is that A-6 is going to try and solve problems before they occur.

O-RING QUALITY STANDARDS . . . Studies of types and effects of O-ring defects will be reported on in minutes of this meeting. Inspection procedures, and system failures and malfunctions stemming from O-ring defects will be included.

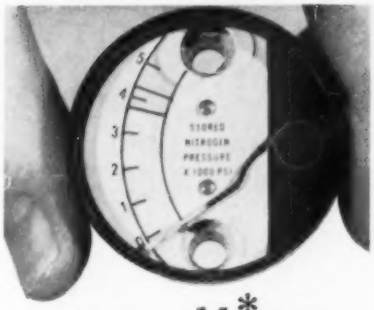
MAKE THEM FAIL . . . J. C. Bloom, Douglas, said that many qualification tests are worthless because too much effort goes into making things work instead of trying to find out what might make them fail. Making them fail and finding out why could prevent embarassing service failures.

NEW BRAZING TECHNIQUE . . . using stainless steel foil was talked about by Frank Mittell, North American Aviation. Technique was used on X-15. Joints have been impulse and burst tested successfully.

QUARTER-MILLION DOLLAR VALVE . . . Subcommittee A-6D members are concerned with high cost of development for missiles. Example: a $250,000 test setup to qualify a single valve. Few suppliers can gamble this kind of money on something that may never be purchased in production quantities. Missile progress makes this kind of situation necessary. Solution seems to be use of outside, accredited labs for tests.

MORE TO FOLLOW . . . A complete report on happenings at the Fall Meeting of SAE A-6 and its subcommittees will appear in February 1959 issue APPLIED HYDRAULICS & PNEUMATICS.

CIRCLE 56 ON TIME-SAVER CARD



miniaturized *bh** gauges

*This **bourdon helix** gauge, designed for the Bendix built "Talos" missile, has no external fittings.

Fits into a 1" space, and bolts directly through the dial face.

When you need specially designed pressure gauges, consult Glassco, a pioneer in miniaturized pressure gauges.

For details, ask for Bulletin G-1117

Glassco

Instrument Company

660 S. Fair Oaks Avenue • Pasadena 2, California

BREATHER-FILTER

protects housings, crankcases, storage tanks.

The Air-Maze breather-filter keeps dust out of engine and compressor crankcases, gearcases, hydraulic equipment, liquid storage tanks and machinery. Types and sizes available in both oil-wetted and oil bath models to protect every vented housing.

In the oil-wetted type, dust is impinged on a series of oil-wetted wire baffles. In the oil bath type, used where the dust concentration is unusually high, the filter media is enclosed in a bowl. Outside air must first pass through the oil, then the filter media, before entering crankcase or housing. Also functions as a backfire flame arrester.

Available in sizes from ⅛" to 3½". Permanent, all-metal, easily cleanable. Write for booklet AH-11. Made by AIR-MAZE CORPORATION, Cleveland 28, Ohio.

CIRCLE 5 ON TIME-SAVER CARD

TRU-FLATE'S Famous Industrial Blo-Dri Gun

- *It Sprays*
- *It Cleans*
- *It Blows*
- *It Dries*

5 Times More Air! !

Worried About...

Volume
Pressure
Cost
Safety

. . . then try the Tru-Flate all-purpose No. 410 Blo-Dri Gun—used extensively throughout the country by large and small industrial factories, foundries, shops, garages, etc. Hand-lever controlled valve can be adjusted from a mere whisper to a full scale blast. Delivers five times the volume of an ordinary blow gun. Highly recommended by safety, maintenance and production engineers.

Write for Catalog on this and other custom designed Tru-Flate Blow Guns Today

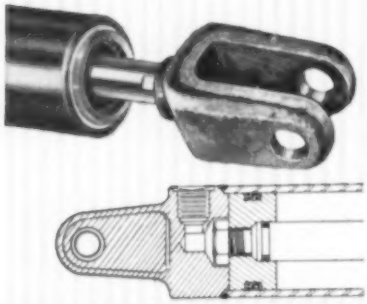
TRU-FLATE, INC.

● 888-92nd Avenue • OAKLAND 3, CALIF.

CIRCLE 127 ON TIME-SAVER CARD

3000 PSI

MAXIMUM QUALITY
MINIMUM COST



DECCTO
CYLINDER

Saves Weight—Space—Cost

Check these advantages:

- Clean, trouble-free design.
- Exclusive "Bruning-ized" bore.
- Single or double action.
- Extremely wide selection of bores, rod diameters and mounting combinations.
- For both hydraulic and pneumatic applications.
- 3000 PSI operating pressure.
- Excellent performance standards.
- Easily adapted to customer specials.
- Premium quality.
- Minimum cost.

COMPARE PRICE AND DELIVERY

For original equipment or replacement parts specify Bruning DECCTO cylinders.

Bruning has a complete line of high performance hydraulic and pneumatic couplers, cylinders and check valves.

WRITE FOR FREE BULLETIN
No. 554-18

THE BRUNING COMPANY

609 So. 9th St., Lincoln, Nebraska

CIRCLE 21 ON TIME-SAVER CARD

NEW PRODUCTS

DIRECTIONAL VALVES
. . . for 6000 psi

Designation: VM6506 Series

Features: Pressure-balanced slide gives low handle pressure. Good throttling characteristics. Low internal leakage (5 cc per min at 2000 psi). Can be stacked up to

six segments in an assembly. Series-parallel type, 3-position, 4-connection, open-center, manually operated with detents optional.

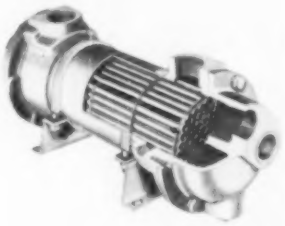
Dynex Inc.
Pewaukee, Wis.

CIRCLE 309 ON TIME-SAVER CARD

HEAT EXCHANGERS
. . . have high efficiency

Designation: Perfexchanger Type B

Features: Fixed-bundle shell-and-tube-type with baffle which prevents fluid by-pass and increases



efficiency. Tubes are spaced on triangular pitch giving maximum heat transfer with minimum pressure drop. Made with ¼- or ⅜-in. tubes.

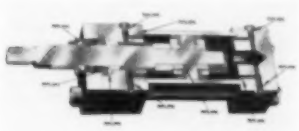
Specifications: Sizes from 1.3 to 200 sq. ft. Made in single, two, and four-pass models.

Perfex Corp.
Milwaukee, Wis.

CIRCLE 310 ON TIME-SAVER CARD

HYDRAULIC CYLINDERS
. . . have Teflon seals

Features: Designed for safety having all seals that prevent external leaks made of Teflon. Will withstand temperatures to 450 F. Rod seals are guaranteed not to leak one



drop of oil. Not affected by non-flammable hydraulic fluids.

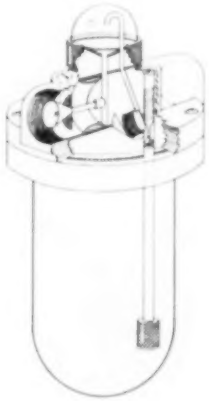
Specifications: Teflon seals are standard on the entire line of hydraulic cylinders. This includes the job-rated cylinders for 500 to 2500 psi and the power-packed line for 3000 to 5000 psi.

Miller Fluid Power Div.
Flick-Reedy Corp.
Melrose Park, Ill.

CIRCLE 311 ON TIME-SAVER CARD

AIR LINE LUBRICATOR
. . . has low pressure drop

Features: Delivers oil only when air is moving. Oil can be regulated for large or small volumes of air. Moisture will not collect in reservoir. Plastic dome gives visual indication



of oil flow. Can be filled from either side. Independent regulation of oil and air flow. Porous bronze filter on siphon tube.

Specifications: Pipe sizes from ¼ to ½ in. Capacities to 100 cfm and pressures to 250 psi.

EMCO Pneumatic Corp.
Des Moines, Iowa

CIRCLE 312 ON TIME-SAVER CARD

Continued on page 132

CIRCLE 6 ON TIME-SAVER CARD

AIR-MITE AIR CYLINDERS

AIR-MITE Cylinders—made in Single or Double Acting Series, in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling, or lifting is required, AIR-MITE Cylinders will meet your most exacting requirements of dependability and long life. Write for complete catalog and prices.

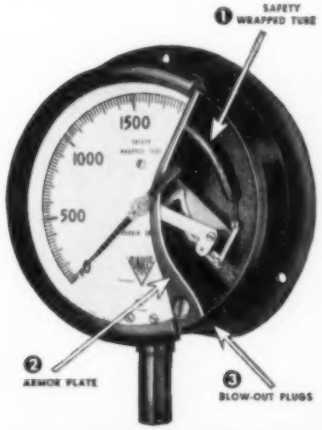
QUALITY FEATURES:

1. Ground and polished steel ram
2. Brass, true-bore cylinders
3. High strength aluminum alloy cylinder heads
4. Bronze oilless ram bushing
5. Five steel tie rods

AIR-MITE DEVICES, INC.
4401 W. Kinzie St., Chicago 24, Ill.

HI-RELIABILITY GAUGES NOW CATALOGED WITH SPEC. DATA FOR HYDRAULIC APPLICATIONS...

15 p.s.i., or 30" of vacuum, to 20,000 p.s.i., including the



TRIPLE-GUARD SAFETY-TYPE

KUNKLE GAUGES

Backed by 50 years gauge manufacturing experience. Guaranteed accuracy. Tubes, cases and movements to specifications. Bourdon tubes in all metals as required.

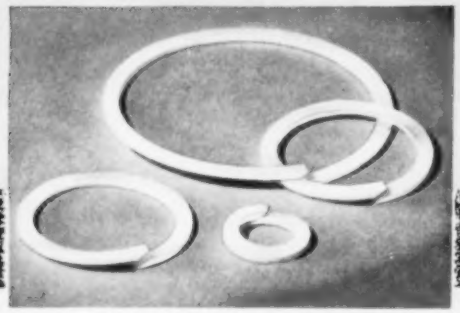
NEW

WRITE FOR CATALOG & ENGINEERING DATA

KUNKLE VALVE CO. • FT. WAYNE, IND.

CIRCLE 80 ON TIME-SAVER CARD

H·I·S PRECISION TEFLON* for LIFE-TIME & TROUBLE-FREE HYDRAULIC SERVICE

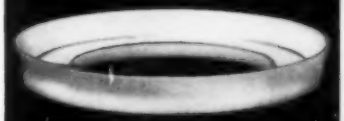


Single Turn Back-up RINGS . . .

ALL THE NEW MILITARY SIZES — MS-28774, MS-28777 and MS-9058.

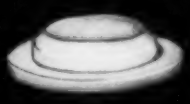
Accurately machined to assure you the fullest utility range and life of your equipment.

Only HALOGEN offers "MEMORIZED" TEFLON


Style 310 Piston Cups

Style 614 V Rings

Style 410 U Cups and Blocked Vees


Style 210 Flange Seals

Halogen cylinder packing is known for operating successfully and efficiently over the widest temperature and pressure ranges . . . because they are "MEMORIZED".

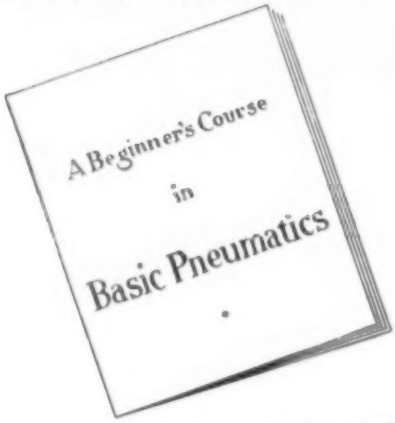
This is an EXCLUSIVE process which makes the packing lip "remember" the size of the rod or cylinder . . . and keeps it in sealing position, regardless of temperature variations.

Send your prints for assembly details and find out about FIELD PROVEN AND ENGINEERED "TEFLON by HALOGEN."

Write for complete catalog on "TEFLON HYDRAULIC SEALS" . . . it's FREE!

HALOGEN
INSULATOR & SEAL CORP.
9960 Pacific Avenue, Franklin Park, Illinois. GLadstone 5-9000
Engineers and manufacturers of products of TEFLON *DuPont T.M.

CIRCLE 62 ON TIME-SAVER CARD



Again Available!

First printed in July 1954, 5000 copies of this popular booklet were bought by more than 800 companies and individuals. A second printing makes this course available to you.

$1.50 per copy

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ORDER FROM APPLIED HYDRAULICS & PNEUMATICS
812 HURON ROAD • CLEVELAND 15, OHIO

NEW PRODUCTS

O-RINGS
. . . in handy kit

Designation: Select-O-Ring Kit No. 2

Features: Contains 180 O-rings in sizes 1 to 25. Case is shock-resistant plastic and has a gage. O-rings are stacked on pegs the size of the

shaft they seal. A gage molded in the kit gives cross section size. Complete interchange information is supplied with kit.

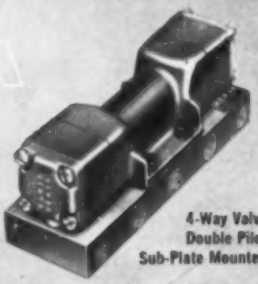
Bearings Inc.
Cleveland, Ohio

CIRCLE 313 ON TIME-SAVER CARD

FOR SUB-PLATE MOUNTING

VERSA

Manifold Mount VALVES



4-Way Valve
Double Pilot
Sub-Plate Mounted

For any type of operation... there's a Versa Control Valve available for manifold mounting. These efficient, compact Control Valves are ideal for incorporation as original equipment. They can be installed directly on equipment or mounted on standard Manifold Plates (or Sub-Plates).

Versa Manifold Mount Valves are available with any type of actuating device, in sizes from 1/8" to 1" NPT, in 2-, 3-, 4-, and 5-Way Types, and for pressures from partial vacuum to 500 PSIG.

Over 110,000 Variations...
Available for Immediate Delivery!

VERSA

VERSA PRODUCTS COMPANY INC.
248A SCHOLES STREET, BROOKLYN 6, N.Y.

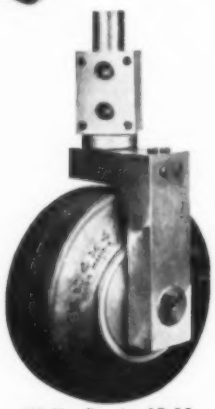
CIRCLE 134 ON TIME-SAVER CARD

TOG-OIL®
Double-Acting,
Toggle Linkage
HAND PUMPS

- Variable Leverage Ratio up to 3.5:1
- Models for 1000, 3000, and 10,000 P.S.I.

HYDRO-WHEEL®
Makes Platform Lifts
SELF-PROPELLED

- Gives 360° Steering
- Simple, Safe, Easy-to-Install



► Rotary Pumps
► Needle Valves
► 4 and 5 Way Valves

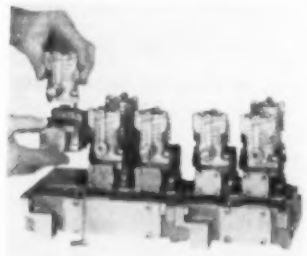
Write Dept. AP-11

MECHANISMS CO. 118 E. 2nd St. Uhrichsville, Ohio

CIRCLE 87 ON TIME-SAVER CARD

AIR VALVE MANIFOLD
. . . for plug-in valves

Features: Built in plugs and connectors for electrical connections. Reduce installation and maintenance costs. For the company's Speed King valves. Fast response,



compact size, and low cost. Made in two and three-station for any number of valves. Made of aluminum with ¼-in. NPT ports, side or bottom. For single- or double-solenoid valves.

Valvair Corp.
Akron, Ohio
CIRCLE 314 ON TIME-SAVER CARD

SOLENOID SHUT-OFF VALVES
. . . have high flow rate

Designation: L Series

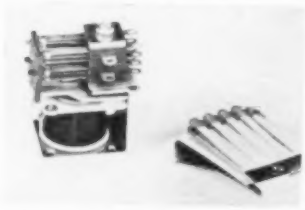
Features: For air, oil or water. Are small, compact and low cost. Operate on pressure differential of 5 to 150 psi. Made in standard and

explosion-proof construction, normally open or normally closed. Can be mounted in any position. Diaphragm supported in both open and closed position. Soft synthetic inserts seal bubbletight.

Specifications: Sizes ¾ and 1-in. NPT. Forged brass body and stainless steel internal trim.

Skinner Electric Valve Div.
Skinner Chuck Co.
New Britain, Conn.
CIRCLE 315 ON TIME-SAVER CARD

MINIATURE RELAYS
. . . have high amp rating



Features: Steel for the magnetic circuit is a special alloy having no residual magnetism. Armature is crimped to allow reducing relay gap which aids in making unit small.

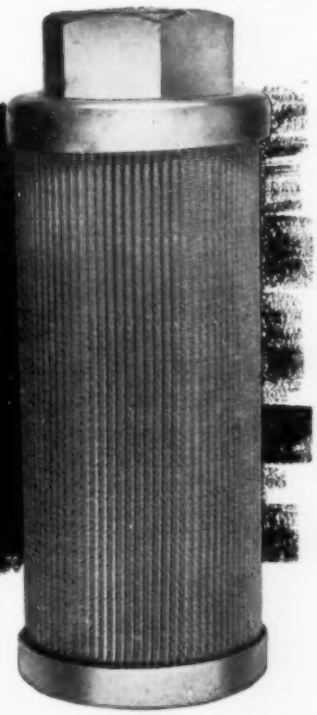
Specifications: Two types are made. One can be mounted in a 1½-in. square and has a 10 amp rating at 110v ac, for single to 4-pole circuits. The other is rated at 15 amp, 110v ac for single and double pole.

Acro Div.
Robertshaw-Fulton Controls Co.
Columbus, Ohio
CIRCLE 316 ON TIME-SAVER CARD

Continued on page 135

Capital

HYDRAULIC OIL FILTER
with
Monel Metal Insert
Reservoir Type for Hydraulic and Oil Re-circulating Machinery



EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS

★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

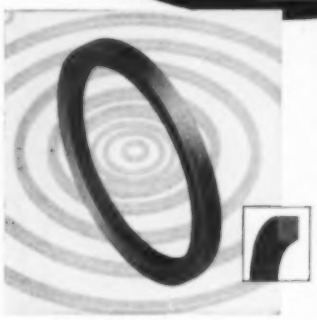
Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.
5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS
CIRCLE 22 ON TIME-SAVER CARD

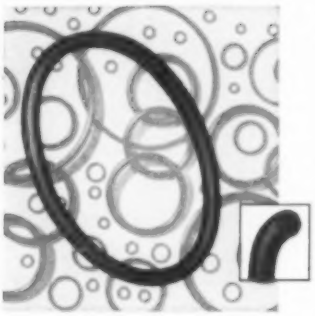
WHEN YOU *Specify* CRITICAL **SEALS** *by* Goshen Rubber



TETRASEALS

save money with seals of rectangular section design.

Precision-cut to extremely fine tolerances, TETRASEALS provide the answer to better dynamic sealing at lower cost. Resulting from precision fabricating methods developed exclusively by Goshen, TETRASEALS not only are equal in quality to standard O-rings, but are interchangeable with them . . . use the same groove.



O-RINGS OF SILICONE

Now, dimensions and tolerances of AN, MS, SAE, JIC and NAS are met consistently with standard tooling from compounds useful over a temperature range of —80° F to +500° F. Non-toxic, too. Lower unit costs, fewer rejects, faster delivery, are other advantages.

TETRASEALS and O-rings by Goshen are available in natural, synthetic and silicone rubber compounds to meet MIL, AMS, SAE, ASTM and industrial specifications.

When it comes to critical seals, come to Goshen.

Send for Literature

☐ TETRASEALS ☐ GORLUBE (Low Friction Treatment)
☐ O-RINGS ☐ GROMMETS

Goshen Rubber Co., INC.

1311-8 S. TENTH ST. GOSHEN, INDIANA

CIRCLE 57 ON TIME-SAVER CARD

CIRCLE 25 ON TIME-SAVER CARD

Standard *For* Industry

CENTURY Liquid Level SIGHT GAGES

- **Easiest Possible Installation on any wall thickness**
- **Large Face for Better Visibility— 7" Overall**
- **Can be used with non-inflammable oil**
- **Leak-Proof — No Dripping**
- **For Better Service at Lower Costs, Start Using Century Gages Today**
- **Available Immediately — from STOCK**

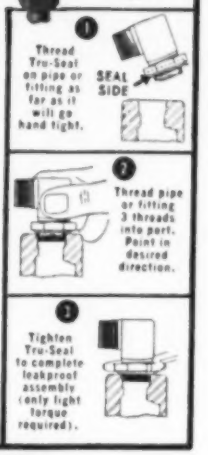
Send for new catalog containing dimensional information on hydraulic reservoirs and complete line of power unit accessories.

CENTURY HYDRAULICS
Division of CENTURY-DETROIT
7701 LYNDON AVE. • DETROIT 38, MICH.
Telephone: Diamond 1-3797

PAT. PENDING

Eliminates leaks in oil, air, water, vacuum, chemical lines

Tru-Seal saves hours in assembling piping installations because it enables you to run your pipe lines in any direction you wish, quickly and easily—without having to recut and re-thread piping sections. Wherever used on air, oil, water, steam, vacuum or chemical lines, it seals perfectly at —100° F. to plus 500° F.—*without the use of pipe dope.* Its installation requires only light tightening torque, thus eliminating over-tightening damage to valves, pumps, compressors, and other fittings.


1
Thread Tru-Seal on pipe or fitting as far as it will go hand tight.
SEAL SIDE
2
Thread pipe or fitting 3 threads into port. Point in desired direction.
3
Tighten Tru-Seal to complete leakproof assembly (only light torque required).

For further information write

TRU-SEAL DIVISION
FLICK REEDY CORPORATION
2008 N. Hawthorne, Melrose Park, Ill.
"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.

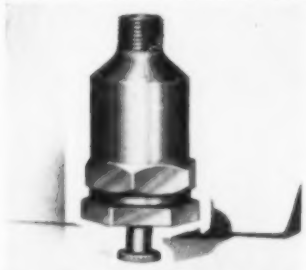
CIRCLE 128 ON TIME-SAVER CARD

NEW PRODUCTS

FILTER DRAIN
. . . is automatic

Designation: Model 458

Features: Opens automatically when air line is shut down overnight or between shifts. Can be used on air filters, air lines, aftercoolers and drain-legs. When pressure falls to 10 psi the petcock opens and contaminants are forced out. When pressure builds up to 15 psi the unit closes. Can also be operated manually.



Wilkerson Corp.
Englewood, Col.

CIRCLE 317 ON TIME-SAVER CARD

AIR COMPRESSOR
. . . uses rotary-screw principle

Features: Delivers oil-free air since no lubrication is used in compression chamber. Maintenance is low because the rotors do not contact each other during operation. Not sensitive to impure air. Cooling water consumption is low. Needs little floor space and light foundation.

Specifications: Capacities to 19,250 cfm at speeds of 3600 rpm.

Atlas Copco
New York, N. Y.

CIRCLE 318 ON TIME-SAVER CARD

EVAPORATIVE HEAT EXCHANGER
. . . is cleanable

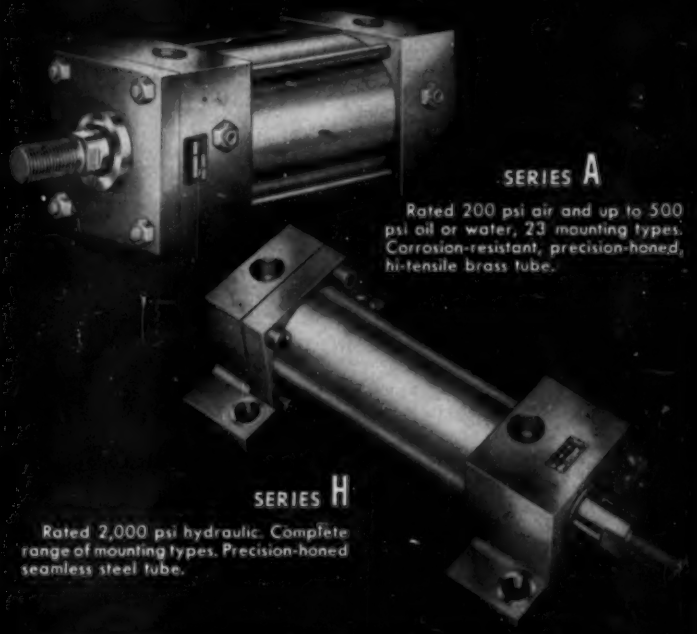
Designation: Series 44-HOO

Features: For air, water and hydrau-

Continued on next page

for increased production . . .
minimum down-time . . .
lower costs . . . specify SP

AIR and HYDRAULIC CYLINDERS



SERIES A

Rated 200 psi air and up to 500 psi oil or water, 23 mounting types. Corrosion-resistant, precision-honed, hi-tensile brass tube.

SERIES H

Rated 2,000 psi hydraulic. Complete range of mounting types. Precision-honed seamless steel tube.

- floating cushions—uniform cushioning—long life—fully adjustable
- easily removed cartridge-type rod seals with integral rod wiper
- choice of rod sizes for all applications—rods heat-treated and hard chrome plated for resistance to nicking and scoring
- steel heads and end plates for strength and positive alignment
- all ferrous parts rust-proofed

Before you buy any cylinder, consider the quality design and construction features of S-P air and hydraulic cylinders—features that will assure dependable performance . . . long service life . . . minimum down-time . . . lowest end cost.

What's your cylinder problem? We'd like to help you solve it—a phone call will bring our representative on the double. Prompt deliveries, too. The S-P Manufacturing Corporation, 30201 Aurora Road, Solon, Ohio.

SP for speed and performance

Representatives in principal cities. Phone or write for Catalogs No. 1108 (Series A) and No. 104A (Series H).

Find us fast in the "Yellow Pages"

NON-ROTATING AIR AND HYDRAULIC CYLINDERS • ROTATING AIR AND HYDRAULIC CYLINDERS • POWER CHUCKS • COLLET AND DRILL PRESS CHUCKS • VALVES, ACCESSORIES

A BASSETT COMPANY • IN GREATER CLEVELAND • ESTABLISHED 1916

AA-1487

CIRCLE 115 ON TIME-SAVER CARD

NEW PRODUCTS

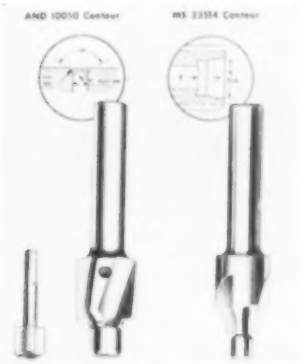
lic fluids. Evaporation of water over cooling coils gives cooling rate of 1000 BTU per pound of water evaporated. The air stream in which heat is rejected, enters at the top of one side, travels down through the spray chamber and is drawn up through the plenum and discharged by propeller fans. Control of temperature is automatic, governed by

modulating the amount of air circulated. Sizes to 18,000,000 BTU/hr.

Niagra Blower Co.
New York, N. Y.
CIRCLE 319 ON TIME-SAVER CARD

PROFILE CUTTERS
. . . for hydraulic ports

Features: Made of form relieved high speed steel for AND 10050 hydraulic ports and MS33514 flareless tube connector. Ports can be

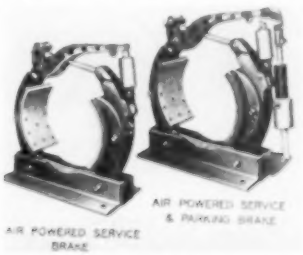


cut in one pass. Made in all sizes. For steel or aluminum. AND 10050 cutter has replaceable plain pilot or high speed steel reamer. Both are also made with carbide tip.

Craig Tools Inc.
El Segundo, Calif.
CIRCLE 320 ON TIME-SAVER CARD

INDUSTRIAL AIR BRAKES
. . . give smooth stops

Features: Two types are made, one for making service stops only, and the other for service stops and parking. On the first system the brake is applied by an air cylinder with a



return spring for quick release. The second has in addition to the stopping cylinder, a spring-applied air-released parking cylinder.

Specifications: Made in two sizes, 14 by 6 in. and 18 by 8 in. external shoe type brake.

Wagner Electric Corp.
St. Louis, Mo.
CIRCLE 321 ON TIME-SAVER CARD

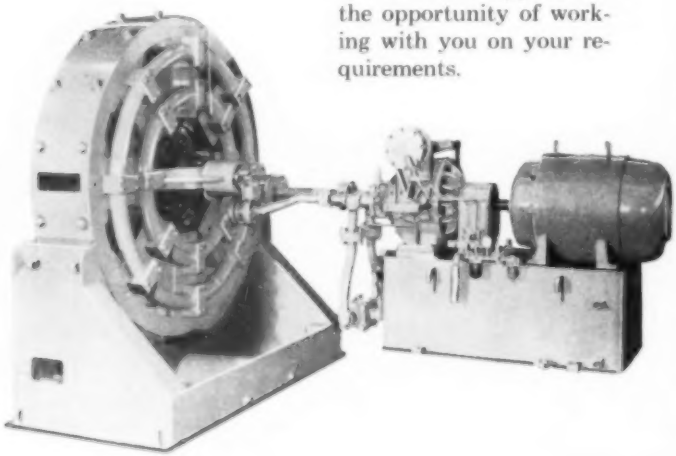
It's Lassman for unusual

HEAVY-DUTY EQUIPMENT

A 600-TON SQUEEZE EVERY SECOND . . . that's what this tube pointer produces. In terms of the hydraulic power unit which operates it, this means reversing a flow of 45 GPM at pressures to 3000 p.s.i. every *one-half second*. And, of course, this must be done quietly, smoothly and without excessive heat generation.

Lassman-designed-and-built equipment is able to provide this and other types of unusual heavy-duty service because it is carefully engineered for the specific application.

We would appreciate the opportunity of working with you on your requirements.



Quality EQUIPMENT for *Quality* PERFORMANCE

BENJAMIN LASSMAN & SON Route 8, GLENSHAW, PA.

CIRCLE 145 ON TIME-SAVER CARD

NEEDLE VALVES
. . . for 10,000 psi

Designation: Series 100

Features: Nylon stem wiper prevents foreign matter from entering and scratching ground stem. Guar-

anteed leak-proof through packing from vacuum to 10,000 psi. Integral bonnet. Forged steel bodies in globe or angle pattern. Cross-bar handles of die-cast aluminum. Operating temperature —40 to 500 F.

Hoke Inc.
Cresskill, N. J.

CIRCLE 322 ON TIME-SAVER CARD

SEPARATOR
. . . has high efficiency

Designation: Type T

Features: Straight through pipe connections for easy installation. Air is directed through an annular space

which increases its speed to produce a maximum centrifugal force. The entrained matter which clings to the outer wall drains to the bottom and then to an automatic trap. Entrance to the outlet chamber is enlarged to reduce velocity.

Specifications: Screwed connections through 3 in. Flanged through 8 in.

Wright-Austin Co.
Detroit, Mich.

CIRCLE 323 ON TIME-SAVER CARD

Continued on next page

HYDRAULIC SAFETY BULLETIN

PROTECT HYDRAULIC EQUIPMENT, REDUCE REPLACEMENT COSTS WITH IMPROVED UCON HYDROLUBES

Ucon hydrolube fire-resistant fluids have excellent corrosion- and wear-resistance

Wear and corrosion are responsible for a large slice of the replacement dollar spent on hydraulic equipment. Now, Ucon hydrolubes provide wear and corrosion resistance equal to petroleum oils *plus the additional protection of fire-resistance.*

HYDROLUBES PREVENT CORROSION

Ucon hydrolubes 150-CP and 275-CP provide improved corrosion protection in both liquid and vapor phases over previous hydrolube formulations. Ucon hydrolubes have no adverse effect on steel, cast iron, aluminum, brass, or copper under normal operating conditions. They successfully pass the standard ASTM test for rust-preventive characteristics (ASTM Designation D 665-54). The inhibitors incorporated in the hydrolube fluids not only essentially eliminate rust formation from the water present, but also aid in the reduction of wear.

WEAR-RESISTANCE TOPS

Actual plant installations in a wide variety of industrial hydraulic systems as well as a large number of controlled laboratory tests have shown that wear in vane-type pumps is significantly reduced with Ucon hydrolubes 150-CP and 275-CP in comparison to previous hydrolube formulations. These results have been confirmed in 750-hour—1000 psi standard rotary vane tests at 150°F. conducted by independent laboratories. These tests show that the wear-resistance of "CP" hydrolubes is in the same general range as petroleum hydraulic oils.

Test Results

	Inhibited Petroleum Hydraulic Oil	Ucon Hydrolube 150-CP	Ucon Hydrolube 275-CP
Viscosity at 100°F.,S.U.S.	216	158	276
Weight Loss 12 Vanes	34 mg.	17 mg.	30 mg.
Eccentric Ring	125 mg.	28 mg.	72 mg.
Total	**159 mg.**	**45 mg.**	**102 mg.**

HYDROLUBES ARE ECONOMICAL

Ucon hydrolubes are the economical answer to fire-resistance in hydraulic fluids. Most commercial hydraulic equipment can be easily converted to Ucon hydrolubes with a *minimum of time and expense.* And, Ucon hydrolubes have no harmful effects on neoprene or most other standard packing materials. Reduced leakage losses also have been frequently reported. Ucon hydrolubes are approved by Factory Mutual Laboratories.

Get all the facts on Ucon hydrolubes. Write for the booklet, "Ucon *Hydrolubes Spell Safety.*" Address . . . Department B.

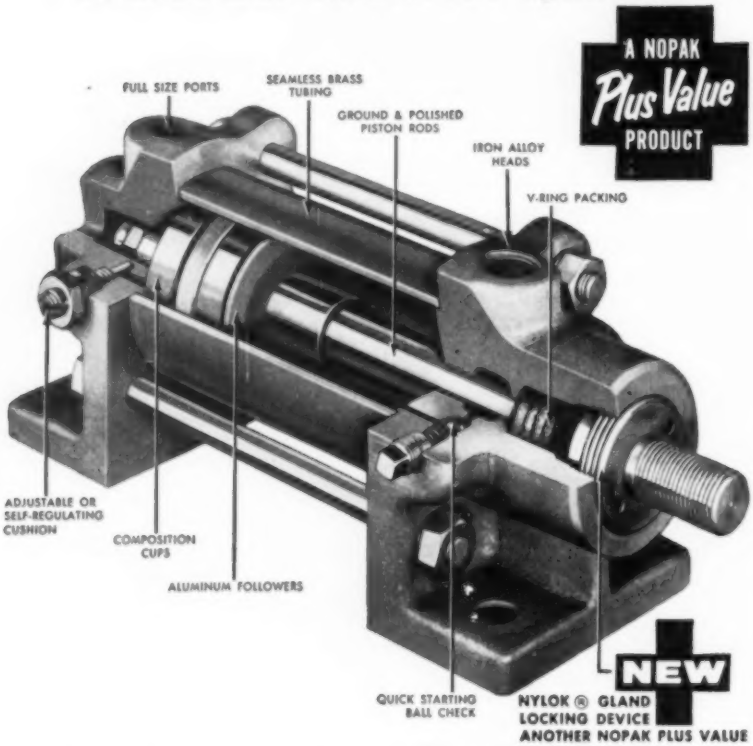
UNION CARBIDE CHEMICALS COMPANY
DIVISION OF UNION CARBIDE CORPORATION
30 E. 42nd Street, New York 17, New York
The terms "Ucon" and "Union Carbide" are registered trade marks of UCC.

CIRCLE 130 ON TIME-SAVER CARD

USE ONE OF THESE
Circle number to receive free information about

Plus Value Performance

is built into NOPAK Air Cylinders



Class 1 and 2 Air Cylinders

Pressures to 250 P.S.I.

Features? Check These—

- **CHOICE OF CUSHIONING ACTION:** All Class 1 and 2 cylinders are available with non-cushioned, self-regulating or adjustable cushioned heads on either or both ends.
- **QUICK STARTING:** Quick opening ball-check valve assures starting under full power.
- **LIGHTWEIGHT COMPONENTS:** Piston follower and follower-ring made of aluminum, wherever suitable, reduce piston weight up to 60%, result in faster starting, more power, longer cup-packing life in horizontally mounted cylinders, reduced impact.
- **PISTON PACKING TYPES:** Standard piston assemblies utilize dependable composition self-sealing cups, for air, oil or water service. Other types available include:
  Leather cups for medium and low pressure
  Impregnated fabric cups for high pressure oil or water
  Graphite impregnated cups for high temperatures
  Piston-ring type for special applications
- **SELF-LOCKING PACKING GLAND:** New gland design utilizes Nylok ® for positive locking.
- **SELF-COMPENSATING V-RING PACKING:** Requires no adjustment; assures longest possible trouble-free operation.
- **BRASS TUBING:** Hard drawn, seamless, straight and concentric; impervious to corrosion.
- **CYLINDER HEADS:** Iron Alloy for durability and long life.

Shelf-Stock Service on Standard Models

NOPAK Class 1 Self-Regulating Cushion Air Cylinders are available from stock in a range of bore sizes and stroke lengths from 1½" x 1" to 8" x 15" in 6 Standard Models. Ask your NOPAK representative for the latest NOPAK Shelf Stock listings, or they will be sent with your request for Catalog 101-A covering the complete line of NOPAK Air Cylinders.

® Registered Trade Mark, The Nylok Corp.

Representatives in Principal Cities

NOPAK VALVES and CYLINDERS

Galland-Henning NOPAK Division • 2743 S. 31st Street • Milwaukee 46, Wis.

CIRCLE 54 ON TIME-SAVER CARD

NEW PRODUCTS

HYDRAULIC MOTOR
. . . for low-speed and high-torque

Features: Infinite variable speed from 0 to 50 rpm in either direction. Constant torque output over entire range. Oil system totally en-

closed. No clutch needed. Gear box is eliminated.

Specifications: Five cylinders having 4-in. bore and 3-in. stroke. Volume displaced per revolution 0.68 gal. Maximum operating pressure 1500 psi. Maximum speed 50 rpm. Weight 500 lbs.

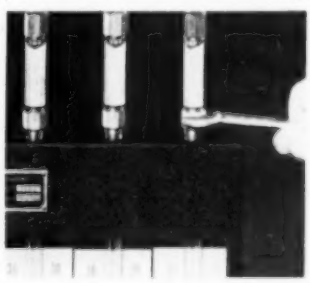
Chamberlain Industries Ltd.
Leyton, London

CIRCLE 324 ON TIME-SAVER CARD

MANOMETER CHECK VALVE
. . . prevents fluid loss

Features: Mounted at top of manometer tube it will let air out but a Teflon float stops any fluid from escaping. Body is stainless steel. Valves do not affect accuracy of manometer.

Specifications: Size 3¾ in. long by ⅝ in. dia. Can be used on single



or multi-tube manometers. Connections are ¼ in. NPT. Good for 500 psi.

Meriam Instrument Co.
Cleveland, Ohio

CIRCLE 325 ON TIME-SAVER CARD

Continued on page 141

USE ONE OF THESE TIME-SAVER CARDS...

...for more information on advertised products, new components, useful literature, etc. Just circle item number and drop in the mail.

New Products

Descriptions start on page 56

HYDRAULIC PUMP & MOTOR 300
Brown & Sharpe Mfg. Co.

FILLER CAP 301
Bendix Filter Div., Bendix Aviation Corp.

HYDRAULIC CHECK 302
Appco Corp.

DIRECTIONAL VALVES 303
Wooster Div., Borg Warner Corp.

HYDRAULIC POWER PACK 304
Wisconsin Hydraulics Inc.

TIME DELAY RELAY 305
Clark Controller Co.

SOLENOID VALVE 306
Automatic Switch Co.

HIGH PRESSURE CONTROL VALVES 307
Barksdale Valves

AIR CYLINDER 308
Bimba Hardware & Mfg. Co.

DIRECTIONAL VALVES 309
Dynex Inc.

HEAT EXCHANGERS 310
Perfex Corp.

HYDRAULIC CYLINDERS 311
Miller Fluid Power Div., Flick Reedy Corp.

AIR LINE LUBRICATOR 312
EMCO Pneumatic Corp.

O-RINGS 313
Bearings Inc.

AIR VALVE MANIFOLD 314
Valvair Corp.

SOLENOID SHUT-OFF VALVE 315
Skinner Electric Valve Div.

MINIATURE RELAYS 316
Acro Div., Robertshaw-Fulton Controls Co.

FILTER DRAIN 317
Wilkerson Corp.

AIR COMPRESSOR 318
Atlas Copco

EVAPORATIVE HEAT EXCHANGER 319
Niagra Blower Co.

PROFILE CUTTERS 320
Craig Tools Inc.

INDUSTRIAL AIR BRAKES 321
Wagner Electric Corp.

NEEDLE VALVES 322
Hoke Inc.

SEPARATOR 323
Wright-Austin Co.

HYDRAULIC MOTOR 324
Chamberlain Industries Ltd.

MANOMETER CHECK VALVE 325
Merlam Instrument Co.

GEAR PUMPS 326
Hydreco Div., New York Air Brake Co.

TWO AND THREE-WAY VALVES 327
A. Schrader's Son

SHUTOFF VALVE 328
Republic Mfg., Co.

CONDENSIFILTER 329
Hankison Corp.

TEST STAND 330
Kahn and Co.

PRESSURE UNLOADING PUMP 331
The Oilgear Co.

NOVEMBER, 1958 Circle number to receive free information about any product described or advertised in this issue.

ADVERTISERS

1	21	41	61	81	101	121	141	161	181	201	221
2	22	42	62	82	102	122	142	162	182	202	222
3	23	43	63	83	103	123	143	163	183	203	223
4	24	44	64	84	104	124	144	164	184	204	224
5	25	45	65	85	105	125	145	165	185	205	225
6	26	46	66	86	106	126	146	166	186	206	226
7	27	47	67	87	107	127	147	167	187	207	227
8	28	48	68	88	108	128	148	168	188	208	228
9	29	49	69	89	109	129	149	169	189	209	229
10	30	50	70	90	110	130	150	170	190	210	230
11	31	51	71	91	111	131	151	171	191	211	231
12	32	52	72	92	112	132	152	172	192	212	232
13	33	53	73	93	113	133	153	173	193	213	233
14	34	54	74	94	114	134	154	174	194	214	234
15	35	55	75	95	115	135	155	175	195	215	235
16	36	56	76	96	116	136	156	176	196	216	236
17	37	57	77	97	117	137	157	177	197	217	237
18	38	58	78	98	118	138	158	178	198	218	238
19	39	59	79	99	119	139	159	179	199	219	239
20	40	60	80	100	120	140	160	180	200	220	240

NAME _____

POSITION: _____

COMPANY: _____

PRODUCT MFG.: _____

STREET _____

CITY _____ ZONE _____ STATE _____

Do not use after 2-15-59

NEW PRODUCTS

300	305	310	315	320	325	330	335
301	306	311	316	321	326	331	336
302	307	312	317	322	327	332	337
303	308	313	318	323	328	333	338
304	309	314	319	324	329	334	339

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400	405	410	415	420	425	430	435
401	406	411	416	421	426	431	436
402	407	412	417	422	427	432	437
403	408	413	418	423	428	433	438
404	409	414	419	424	429	434	439

AVIATION DATA

500	505	510	515	520	525	530	535
501	506	511	516	521	526	531	536
502	507	512	517	522	527	532	537
503	508	513	518	523	528	533	538
504	509	514	519	524	529	534	539

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Useful Literature

Descriptions start on page 62

OIL CONDITIONER 400
Mayhew Products Co.

CHECK VALVES 401
Kepner Products Co.

COMPRESSION PACKINGS 402
E. F. Houghton & Co.

CYLINDER TUBING 403
Babcock & Wilcox Co.

SHAFT SEALS 404
Syntron Co.

BOOSTERS 405
Davies Brothers

HYDRAULIC CYLINDERS 406
Hannifin Co., Div., Parker-Hannifin Corp.

DIAL THERMOMETERS 407
W. C. Dillon & Co.

AIR COMPRESSORS 408
Fuller Co.

DRUM-TYPE CONTROLLERS 409
Sealy Instrument Co.

MANOMETERS 410
King Engineering Corp.

CYLINDERS 411
Bendix-Westinghouse

GEAR PUMP 412
Pesco Products Div., Borg Warner Corp.

MINIATURE SNAP-ACTION SWITCHES 413
Micro Switch Div.

RELIEF VALVES 414
Fluid Controls Inc.

SCREW THREADS 415
Standard Pressed Steel Co.

AIR CYLINDERS 416
Lynair Inc.

HYDRAULIC PUMPS & MOTORS 417
Vickers Inc.

CYLINDER SELECTION 418
Miller Fluid Power Div., Flick-Reedy Corp.

CLAMP CYLINDERS 419
The Sheffer Corp.

LIMIT SWITCHES 420
General Electric Co.

FLARING MACHINE 421
Automation Associates Inc.

ACCUMULATORS 422
Special Products Co.

TEST EQUIPMENT 423
George L. Nankervis Co.

WELDING FITTINGS & FLANGES 424
Babcock & Wilcox Co.

Aviation Component Data

Descriptions start on page 126

SELF-SEALING COUPLINGS 500
Aeroquip Corp.

ELECTRO-HYDRAULIC SERVO SYSTEM 501
Hydraulic Research & Mfg. Co.

INSTRUMENTS 502
Gulton Industries Inc.

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Eckel Valve Co.

SYNTHETIC HYDRAULIC FLUID 504
Dow Corning Corp.

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Raymond Atchley Inc.

VARIABLE-DELIVERY PUMP 506
Vickers Inc.

MISSILE AND ROCKET VALVES 507
Skyvalve Inc.

BRAZED TUBE CONNECTORS 508
Parker Fittings & Hose Div., Parker-Hannifin Corp.

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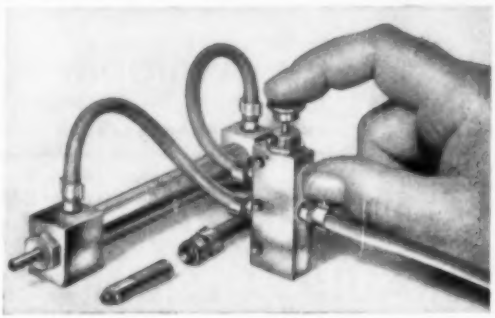
Flexonics Corp.

AIR COMPRESSOR & VACUUM PUMP 510
Lear Inc., Lear-Romec Div.

CIRCLE 30 ON TIME-SAVER CARD

NEW! MORE Powerful 9/16" MINIATURE AIR CYLINDERS · 4-WAY AIR VALVES · QUICK CONNECTS



NEW more powerful 9/16" bore spring return and double acting MINIATURE Air Cylinders to complement our widely used 3/8" bore cylinders. NEW 4-way Air Valve, Quick Connects, A.C. and D.C. Solenoids, fittings, mountings and other needed items to improve your automatic tooling and production devices or new end products. Made for MILLIONS of cycles of trouble-free operation! Modestly priced.

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Manufacturers of R. F. Coils, Electronic Equipment, Miniature Pneumatic Devices

NEW

SINGLE OR 2-SPOOL VALVE

MODEL WP

PARALLEL VALVE

for heavy duty industrial mobile hydraulic applications

GRESEN HYDRAULICS

Capacity: **40 GPM** at 20 ft./sec.

MAX. PRESSURE: 1500 PSI

Features: **SPOOLS** – fully balanced, self centering, accurately feathered for fine metering action – separate ball checks for each spool.

CARTRIDGE type relief valve has hardened seat.

TRIPOD mounting feet for easy installation.

CHOICE of many modifications.

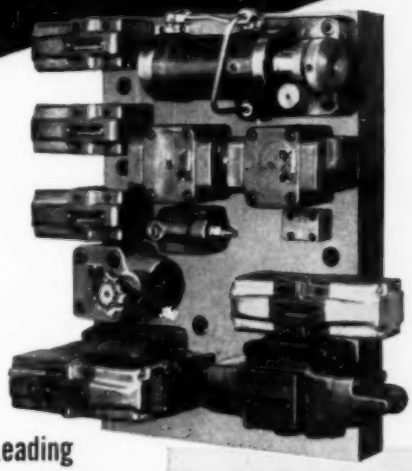
WRITE FOR LITERATURE

GRESEN *Mfg. Co.*

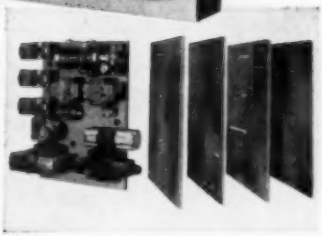
405 35th Ave. N.E., Minneapolis 8, Minn.

CIRCLE 59 ON TIME-SAVER CARD

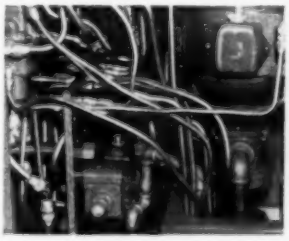
ENGINEER *Simplicity* INTO YOUR HYDRAULIC EQUIPMENT CONTROL SYSTEMS



Leading Hydraulic Manufacturers Are Using Almo Manifolds to Cut Costs and Obtain Permanent Trouble-Free Operation



Almo has perfected the manifold method of channelling hydraulic fluids at high pressures after years of research and can apply it to your equipment. Send a diagram of one of your present hydraulic circuits. Without obligation we will return an Almo Manifold diagram demonstrating how the job can be completely simplified



This maze of piping and tubing, all subject to failure resulting from vibration and deterioration, can be eliminated and made as compact and simple as the unit illustrated above

Write for our new brochure

ALMO TOOL CO.

11470 KALTZ, CENTERLINE, MICH.

CIRCLE 8 ON TIME-SAVER CARD

CIRCLE 1 ON TIME-SAVER CARD

Fall Wiper Ring SPRING LOADED

The Fall "CJ"* Wiper-Scraper Ring is Spring-Loaded causing Squeeze-Grip Action on the O.D. of the piston rod during entire cycle. This patented feature maintains a uniform, continuous pressure on the wiping edge of the ring at all times, stopping any buildup of foreign matter between the ring and the rod.

It automatically takes up wear, maintaining NEW RING PERFORMANCE. Available in diameters ½" through 13" for any commercial use. AN and MS numbers in use by the Military and Aviation industry since 1944. Manufactured in accordance with MIL-S-5049. (*Closed Joint)

ACE PRODUCTS CO.

1820 N. 12th St. Toledo 1, Ohio

Est. 1935

2nd printing now available

AIRCRAFT HYDRAULIC DESIGN

• **The first book** dealing with hydraulic component and system design for high-speed piloted aircraft and missiles, has been written by a leading aircraft engineer. Developed from practical and theoretical material, the book develops many basic equations including those relating pressure gradient, flow-path dimensions, flow rate, velocity, fluid density, and viscosity.

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The Industrial Publishing Corporation

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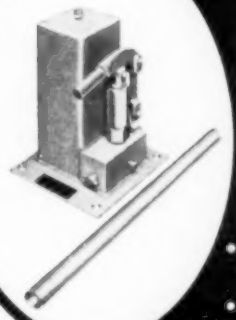
CIRCLE 83 ON TIME-SAVER CARD

CATALOG NO. 160



Hand Hydraulic Pumps

- Single and Double Designs to 20,000 psi
- With or Without Reservoir

160 cubic inch reservoir with 8"x 8" base plate and 18" long handle.

Available with optional size pistons ⅜", ½", ¾", 1" and 1½".

We specialize in the manufacture of hand pump units which operate in temperatures from −65° F. to +160° F. and with any capacity reservoirs required. Pumps can be furnished on special order with custom seals to handle various aircraft types of fuels such as Pydraul, Skydrol, Oronite, etc.

The single pump with ½", ¾", 1" or 1½" piston is now available in stainless steel.

for additional information write:

WILLIAM S. PINE

hydraulic hand pumps for 1001 uses

1635 East 22nd St., Los Angeles 11, Calif.

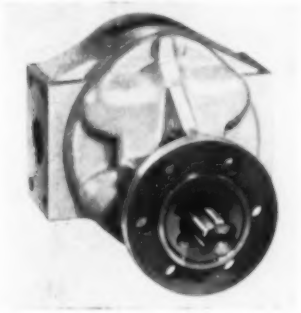
CIRCLE 103 ON TIME-SAVER CARD

NEW PRODUCTS

GEAR PUMPS
. . . have 2-stage high-pressure seals

Designation: 2100 Series

Features: Improved shaft bearings, thrust bearing for axial thrust, and piloted housing to eliminate shifting of internal parts.



Specifications: Pressures to 2000 psi and flows to 40 gpm. Standard flange mounting for mobile application, or foot mounting for industrial use.

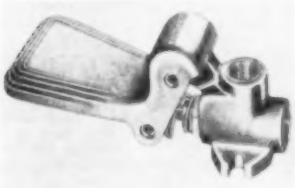
Hydreco Division
The New York Air Brake Co.
Kalamazoo, Mich.

CIRCLE 326 ON TIME-SAVER CARD

TWO AND THREE-WAY VALVES
. . . are foot operated

Designation: No. 3476

Features: Poppet type closed by spring on release of pedal. Built to



withstand vibration and shock and tested to full pressure before being shipped. Stainless steel spring, oil-resistant synthetic rubber seals, and chrome-plated plunger.

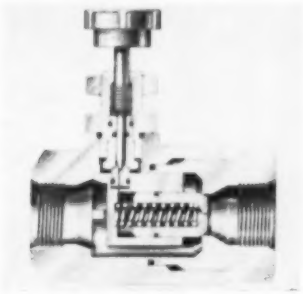
Specifications: Air capacity 75 cfm at 100 psi. Ports are ⅜ in. NPT. All parts are corrosion resistant.

A. Schrader's Son
Div. Scovill Mfg. Co.
Brooklyn, N. Y.

CIRCLE 327 ON TIME-SAVER CARD

SHUTOFF VALVE
. . . is pilot operated

Designation: Ez-O-Trol



Operation: Valve is seated by back pressure in a balancing chamber. Turning the pilot valve causes an unbalanced condition by allowing back pressure to escape. Valve is then forced open. Pilot may be also operated by an air diaphragm or direct-acting solenoid.

Specifications: Aluminum body, stainless steel internal parts. Sizes ½-to 2-in. NPT or O-ring ports. Temperatures —65 to 200 F.

Republic Manufacturing Co.
Cleveland, Ohio

CIRCLE 328 ON TIME-SAVER CARD

Continued on next page

The ARROW AUTOPNEUMATIC CONTROL is the answer to your compressed air problems

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ARROW TOOLS, INC.
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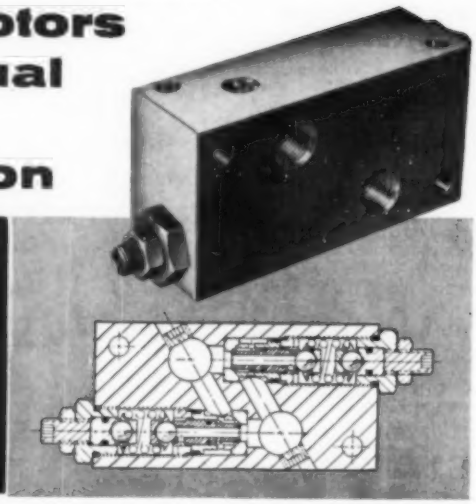
Chicago 23, Illinois

CIRCLE 14 ON TIME-SAVER CARD

CIRCLE 50 ON TIME-SAVER CARD

Fluid Motors Need Dual Relief Protection



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■ Prevent excessive pressures at motor ports when valves are suddenly reversed or blocked.

■ Assure smooth safe starting or deceleration of large loads.

- Pressure on one side may be set higher than on the other
- For Oil
- 100 to 3000 psi
- ⅜", ½" & ¾" pipe sizes

Write for detailed information and prices.

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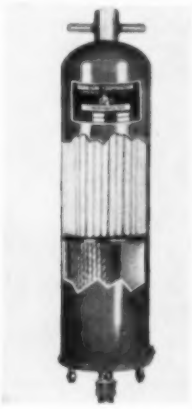
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

NEW PRODUCTS

CONDENSIFILTER
. . . for dehydrating compressed air

Designation: Model M-100



Features: Both inlet and outlet connections are 1½ in. NPT on model M-100, and 1 in. on model M-30. New expanded metal separator in

NEW from DENISON

Automatic

AIR BLEED-OFF VALVE

for pressures up to 5000 psi

New Air Bleed-Off Valve automatically vents air in hydraulic circuits to tank—assures adequate pump priming and efficient operation. Prevents internal damage to pump caused by lock-up due to air in the circuit. Valve is installed in pump discharge line—ahead of any other component—with "T" connection. Valve remains open as long as system pressures remain low and permits air to flow to tank. When air has been dissipated, initial surge of hydraulic fluid closes valve—remains closed until the pressure drops. Recommended applications: use in systems where a pump is required to prime against pressure in a blocked line—or for dual pump installations in which satisfactory operation of one pump might conceal that the other pump is not primed. Dimensions: 2⅜" by 1" hex. Available with ¼" NPT or $^{9}/_{16}$"—18 straight threads. Write for full details in Bulletin VBO-1. Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.

CIRCLE 38 ON TIME-SAVER CARD

AS LOW AS 56.75

20.75 AND UP

WORLD'S LARGEST ON-THE-SHELF STOCK OF HYDRAULICS

NEW PALLEY HYDRAULIC CYLINDERS – Here are two of our newly developed line of double action Industrial Hydraulic Cylinders. These cylinders are designed to meet the most rigid requirements of industry. All are heavy duty steel construction.

Type (A) is a heavy duty, press type cylinder with bores of 3", 5", 6" and 8" – thrust range up to 75 TONS at 3000 PSI.

Type (B) is an internal cap type with bores of 1-1 2", 2", 2-1/2", 3", 3-1/2" and 4". Has strokes from 2" to 48". Delivers up to 18,850 lbs. thrust on 1500 PSI line pressure.

For complete listing of our tremendous stocks and prices – Send for our Special 396 Page Catalog TODAY

Cat. No. H-V13-N

Newly Developed 4-WAY, SLIDING PISTON VALVE

Available in open or closed center types, with spring return or detents. Has built-in relief valve which is adjustable from 1200 to 3100 PSI. Allows flow up to 15 GPM at 3000 PSI. Only . . .$32.75

SURPLUS GOV'T BUYS

2000 PSI HYDRAULIC CYLINDER SPECIAL No. 66 12.75

Genuine top quality Gov't Surplus. Used but excellent condition. Has a Bore of 2-1/4", Shaft 1", Stroke 4", Eye-to-eye lgth. 13½". Ports 1/4" NPT.

ELECT. HYDRAULIC MOTOR-PUMP AS LOW AS $115

Motor designed to face mount any Aircraft type hydraulic pump. For continuous duty with high starting torque. 115/230 V, 220/440 V, 1 and 3 phase, 60 cycle AC. Sizes from 3/4 to 15 HP. Pressure up to 3000 PSI. Further information in catalog below.

VICKERS HYDRAULIC ANGLE PUMPS

Cat. No.	GPM	PSI	RPM	Price
H-P4A	5.3	1000	3000	$22.50*
H-P5A	2.7	1500	3000	25.75*
H-P4U	4	1000	3000	22.50*

*Used but excellent condition.

STRATO POWER PUMP BARGAIN! Delivers 10 GPM at 1500 RPM at 3000 PSI. Cost Gov't approx. $1200 – Cat. No. P-30-D – Now Only $ 175.00

HYDRAULIC TEST STANDS – Available now at remarkable savings. Write for info.

396 PAGE BARGAIN CATALOG – Has largest on-the-shelf stock of Hydraulic Equip. and Supplies ever under one roof. Plus Elect. Motors, Pumps, Tools, etc.

Palley's

ORDER TODAY – Pay by Money Order or Check ½ deposit with C.O.D.'s. All prices F.O.B. Los Angeles.

2363 E. VERNON AVE., DEPT. AH-11 LOS ANGELES 58, CALIF.

CIRCLE 99 ON TIME-SAVER CARD

condensing section keeps entrainments from filter cartridge. A guide-latch between shell and bottom plate simplify assembly after cartridge cleaning.

Hankison Corp.
Canonsburg, Pa.

CIRCLE 329 ON TIME-SAVER CARD

TEST STAND
. . . for pressures to 5000 psi

Designation: KC-300

Features: For hydraulic components and accessories. Gives extensive choice of hydraulic circuits without sacrifice of performance.

Specifications: Basic unit gives pressures to 3000 psi and flows to 6 gpm. Other models made for pressures to 5000 psi and flows to 20 gpm. Self contained and need only to be connected to 220/440 v, 3-phase, 60-cycle, ac.

Kahn and Co.
Hartford, Conn.

CIRCLE 330 ON TIME-SAVER CARD

PRESSURE LOADING PUMP
. . . saves power

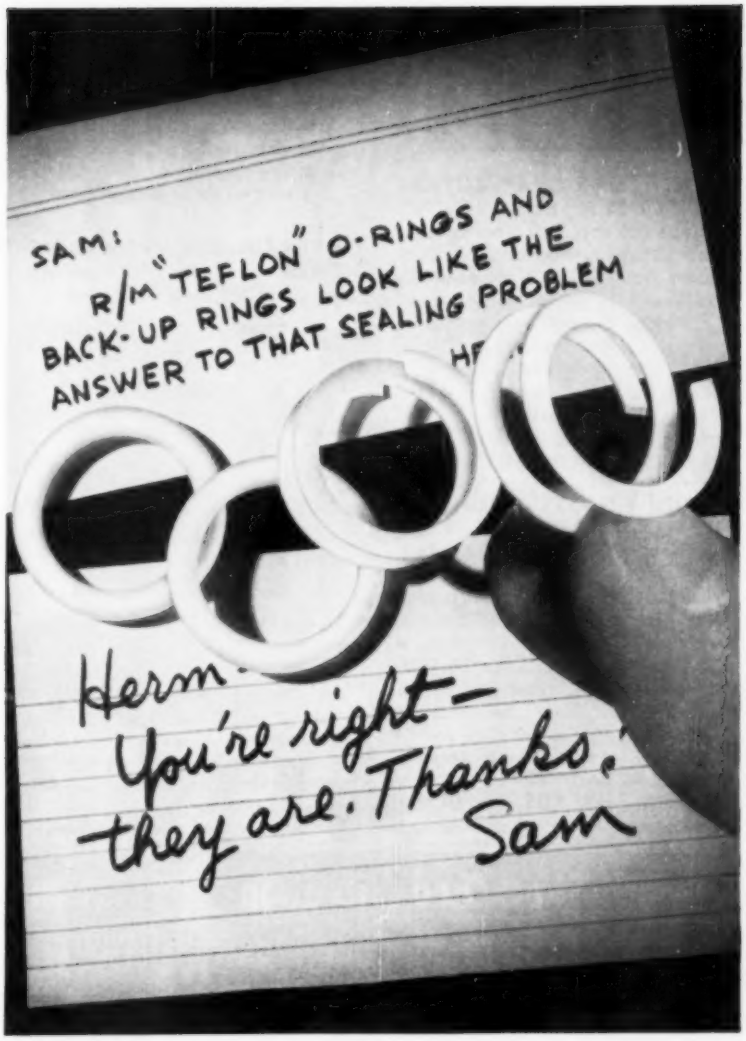
Designation: Type ANP

Features: When preset pressure is reached on the work, a hydraulic control reduces pump volume to slip stroke and holds the pressure which reduces heat and saves power. The pump uses radial rolling pistons and a balanced flat valve plate. Other features are, separate wear plate, integral adjustable volume and pressure unloading control, one piece cylinder and shaft, and large anti-friction bearings.

Specifications: Clockwise or counter-clockwise rotation. Face, right angle bracket or adapter mounting. Working pressures to 1100 psi. Delivery at 1750 rpm, 3100 cipm. Weight, 130 lbs.

The Oilgear Co.
Milwaukee, Wis.

CIRCLE 331 ON TIME-SAVER CARD



"Teflon"* O-Rings and back-up rings, precision machined by R/M, give you a reliable solution to many difficult sealing problems. Top-quality production techniques provide accurate fit and consistent performance.

In addition, the unique characteristics of "Teflon" make it your best choice for handling many difficult liquids. "Teflon" is not affected by any known industrial acids or caustics. It has no known solvent. It is nonadhesive and noncontaminating. It is unaffected by weather, its water absorption is zero, and it performs efficiently within the temperature range -80° to +500°F.

R/M engineers have amassed a wealth of experience in manufacturing packings and gasket materials to satisfy the most exacting requirements of industry. This experience is at your disposal—call on R/M!

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS—including Vee-Flex,* Vee-Square,* Universal Plastic, and "versi-pak"*; GASKET MATERIALS; and "TEFLON" PRODUCTS. SEE YOUR R/M DISTRIBUTOR.
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PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

CIRCLE 108 ON TIME-SAVER CARD

USEFUL LITERATURE

MINIATURE SNAP-ACTION SWITCHES . . . for industrial and commercial application are covered in a 32-page catalog available from *Micro Switch, Div. of Minneapolis Honeywell Regulator Co., Freeport, Ill.* Among the new switches in the revised catalog are the precision, roller-lever switch, the adjustable actuator switch, and the pulse switch. Over 200 basic switches and related devices are listed.

CIRCLE 413 ON TIME-SAVER CARD

RELIEF VALVES . . . differential-piston type are included in a data sheet released by *Fluid Controls Inc., Mentor, Ohio.* It contains complete engineering information and dimensional data on the valves which are made for pressures to 5000 psi in sizes to 1 in. The differential-piston relief valve has good pressure-flow characteristics and is dependable.

CIRCLE 414 ON TIME-SAVER CARD

SCREW THREADS . . . are the theme of a 16-page handbook announced by *Standard Pressed Steel Co., Jenkintown, Pa.* It reviews the function and facilities of the company's laboratories which were recently opened. A 7-page appendix gives data on screw-thread dimensions and tolerances.

CIRCLE 415 ON TIME-SAVER CARD

HYDRAULIC PUMPS AND MOTORS . . . of the axial-piston type for pressures to 1000 psi are presented in a booklet issued by *Vickers Inc., Marine and Ordnance Dept., Waterbury, Conn.* Included are complete dimensions for 18 sizes of units and typical performance curves. A special section describes nine types of manual and automatic controls which can be incorporated in the units.

CIRCLE 417 ON TIME-SAVER CARD

CYLINDER SELECTION . . . is covered in a data sheet available from *Miller Fluid Power Division of Flick-Reedy Corp.* The sheet includes many important factors often overlooked in the choice of cylinders. Shock loads, decompression, rate of pressure rise and fall, and effect of rapidly discharging accumulators are some of the conditions considered.

CIRCLE 418 ON TIME-SAVER CARD

CLAMP CYLINDERS . . . for pressures to 150 psi air and 400 psi hydraulic having 1⅛ in. bore and 1, 2, and 3 in. strokes are described in bulletin 458 published by *The Sheffer Corporation, Cincinnati, Ohio.* Pistons and heads are machined from aluminum and cylinder tubes are mirror-smooth drawn brass. Made for front, rear, and side mounting the cylinders have ⅛ in. NPT ports.

CIRCLE 419 ON TIME-SAVER CARD

LIMIT SWITCHES . . . that are vane-operated and do not require a lever are covered in a leaflet prepared by *General Electric Co., Bloomington, Ill.* It describes the switches that are energized by passing a metal vane through a recessed

Absorb Shock and Vibration in Soft, Cushioned Couplings

Get longer bearing life by eliminating the transmission of shock and vibration from equipment to motor—use flexible couplings with drive inserts of Neoprene. These soft resilient inserts assure equal distribution of driving pressure, and are completely enclosed in the coupling halves. They insulate the coupling, require no lubrication. Find out all the advantages of using Magnaloy couplings. Write today for the Magnaloy Catalog.

DETROIT POWER COUPLING CO.
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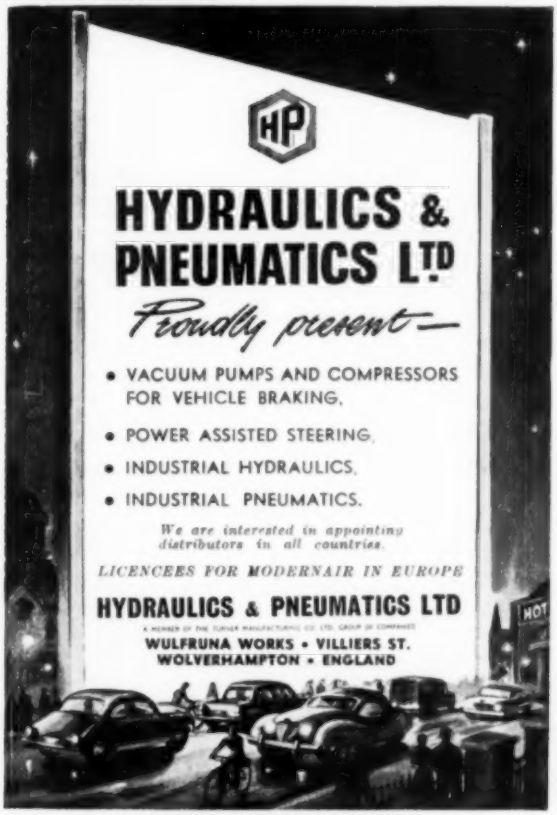
MAGNALOY
FLEXIBLE DRIVE COUPLINGS
PATENTS PENDING

CIRCLE 40 ON TIME-SAVER CARD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HYDRAULICS & PNEUMATICS LTD
Proudly present—
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WULFRUNA WORKS • VILLIERS ST.
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CIRCLE 73 ON TIME-SAVER CARD

slot in the body. When the vane enters the slot it disturbs a magnetic field balance and causes two contacts to open or close. Switch meets all JIC requirements.

CIRCLE 420 ON TIME-SAVER CARD

FLARING MACHINE . . . for 1/8 to 5/8 in. tubing is shown in a brochure released by *Automation Associates Inc., Madison Heights, Mich.* It describes the automatic floor-mounted machine that can flare both ends of tubing at a rate of 180 per min. All exposed gears, chains, and belts are guarded by heavy gauge sheet metal guards. Clutch and brake for the unit are air operated.

CIRCLE 421 ON TIME-SAVER CARD

ACCUMULATORS . . . having capacities of 15 to 7500 cu in. for pressures to 2000 psi are included in a data sheet issued by *Special Products Co., Golden, Calif.* It gives complete information on the hydropneumatic accumulators that use a synthetic rubber diaphragm in the shape of hat to separate the liquid from the gas. Shell is made in two sections, held together with a clamp ring.

CIRCLE 422 ON TIME-SAVER CARD

TEST EQUIPMENT . . . for aircraft and automotive industries is presented in a folder announced by *George L. Nankervis Co., Detroit, Mich.* It has photographs of many of the company's test stands for hydraulic, pneumatic and electronic components for both individual and production testing.

CIRCLE 423 ON TIME-SAVER CARD

WELDING FITTINGS AND FLANGES . . . in three inch size are detailed in technical bulletin FDC-259 from *Babcock and Wilcox Co., Tubular Products Div., Milwaukee, Wis.* This is one in a series of technical bulletins cataloging fittings and flanges by size, dimensions and physical data. Folders are identified numerically from FDC-252 to FDC-275 and include both steel and stainless steel fittings.

CIRCLE 424 ON TIME-SAVER CARD

AIR CYLINDERS . . . for pressures to 200 psi and bores to 10 in. are illustrated in a catalog available from *Lynair Inc., Jackson, Mich.* It contains cut-away views showing the internal construction and pointing out the features. Cylinders are available with or without cushions.

CIRCLE 416 ON TIME-SAVER CARD

all STEEL

New Fulflo all-steel, piston type, oil relief hydraulic by-pass valves combine proven features with the advantages of all-steel construction in flange models from 1" to 3".

FULFLO

ALL-STEEL, ALL-BRASS OR OTHER COMBINATIONS FOR POSITIVE AUTOMATIC PRESSURE CONTROL YOU CAN DEPEND UPON AT ALL TIMES

all BRASS

Fulflo Valves feature shear-closing action for quiet, non-chattering operation. They offer greatest safety, matched to job conditions. Priced right for O.E.M. use . . . built right for superior replacement service.

• Standard and flanged models • Just 6 springs for pressures to 500# • Steel, cast iron or brass bodies • Brass, steel or stainless pistons • Pipe sizes to 3" • Specials to your requirements

COMPLETE CATALOG FREE ON REQUEST

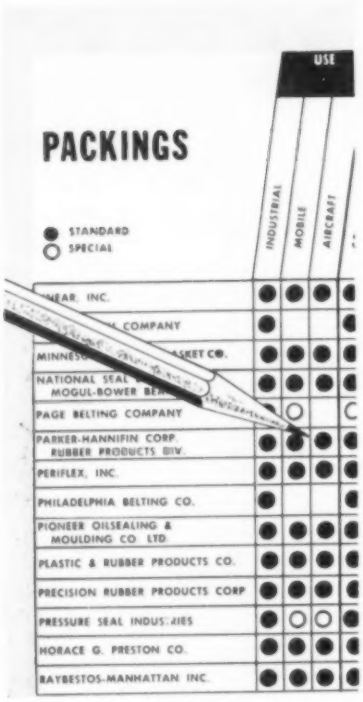
THE FULFLO SPECIALTIES CO., INC.
415 Fancy Avenue, Blanchester, Ohio

FULFLO

CIRCLE 52 ON TIME-SAVER CARD

for that

coming in january



Quick with the answers . . .

• • • that's the Designers' Guide Issue of APPLIED HYDRAULICS & PNEUMATICS in January. It provides 32 Quick Guides to Product Selection to help engineers and users choose fluid power components . . . and a Fluid Power Products Review to help engineers develop new equipment. Make sure your copy is handy!

January Issue

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812 Huron Rd. Cleveland, Ohio

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

The board of directors of **E. F. Houghton & Co.**, Philadelphia, promoted two of their executives, **Frank Ross** to vice president-sales, and **Charles R. Schmitt** to assistant to vice president-sales. David J. Richards, who served with Houghton for 41 years, retired as vice president and director. Ross was formerly assistant to the vice president-sales. He came to the company in 1942, was elected to the board of directors in 1957. In addition to his new responsibilities, Schmitt will continue his position of national manager of the lubrication sales department.

Frank Ross
E. F. Houghton & Co.

C. R. Schmitt
E. F. Houghton & Co.

Jay N. Yhraves has been appointed sales manager of **TA Mfg. Co.**, Los Angeles, Calif. He has been affiliated with TA as a service engineer for the past six years. Two new representatives were also appointed, **R. P. Mohan Co.**, South Lincoln, Mass., and **C. R. Mayer Co.**, Huntington, Long Island.

Al Holden formerly president dent of Pneu-Hydraulics, Inc., Cleveland, Ohio, has organized **Holden Engineering Co.**, to handle sales for **Webster Electric Co., Carter Controls Inc.**, and **Lenz Co.** in Northern Ohio. Offices for the new company are at 2108 Payne Ave., Cleveland, Ohio.

R. W. Cornell, who for the last three years has served as president of **Parker Aircraft Co.**, Los Angeles and a vice president of **Parker-Hannifin** returned to Cleveland to take charge of planning and marketing for all of Parker-Hannifin's industrial products. **W. C. Loeman** was made president of Parker Aircraft Co., to which he was transferred in 1954.

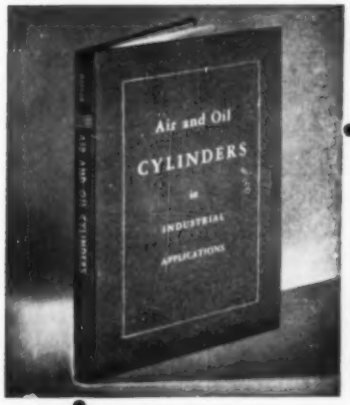
R. A. Powley, president of **Pesco Products Division and Wooster Division, Borg-Warner Corp.**, announced these two appointments: **John F. Murray** to the position of chief product engineer for both divisions and **Donald R. Spotz** to vice president in charge of sales for both divisions. Murray, formerly manager of product engineering at Pesco Products, is now responsible for coordinating all engineering activities for research and development, product engineering and production.

John F. Murray
Borg-Warner Corp.

Gilbert Wilkes III
France Packing Co.

Gilbert Wilkes III has been selected by the **France Packing Company**, Philadelphia, to work with original equipment manufacturers on engineering problems as well as sales development. He was previously associated with the Koppers Co.

Continued on page 148



AIR & OIL CYLINDERS

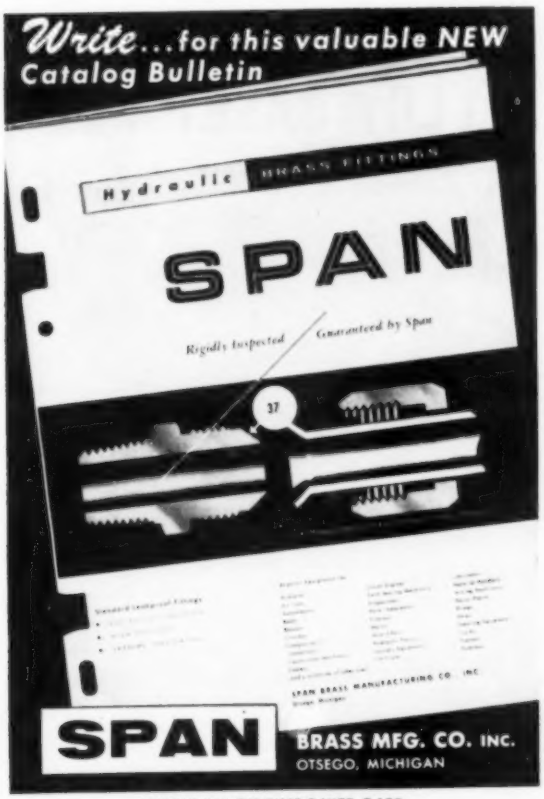
Elmer Heiser has written this valuable cylinder handbook which tells about types, cushions, how to order, proper porting, correct sizing, packings, and efficient installation methods.

It's full of application ideas.

PRICE $5.00

The Industrial Publishing Corporation
812 Huron Road • Cleveland 15, Ohio

Write...for this valuable NEW Catalog Bulletin



SPAN BRASS MFG. CO. INC.
OTSEGO, MICHIGAN

CIRCLE 120 ON TIME-SAVER CARD

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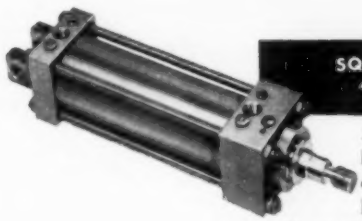
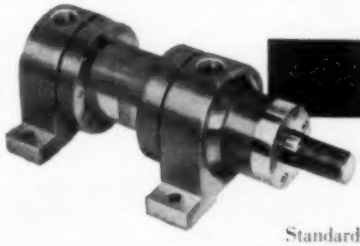
for that BIG PUSH

LINDBERG HAS THE RIGHT CYLINDER



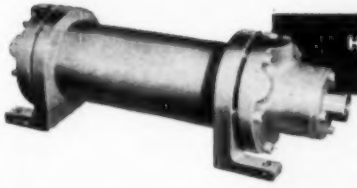
SQUAREHEAD "S" LINE

A feature packed line with the "quick change" feature • Rated 250 psi for air, up to 1000 psi hydraulic • 7 bore sizes thru 6" • Standardized mounting dimensions.
WRITE FOR BULLETIN S-101



2000 PSI "H" LINE

An extra heavy duty hydraulic cylinder • Available with or without cushions • Standard or 2:1 rods • Bore sizes through 8 inches in 5 mounting styles.
WRITE FOR BULLETIN H-101



HEAVY DUTY "A" LINE

A rugged non-tie rod cylinder for air pressures up to 150 psi and low pressure hydraulic service. Bore sizes through 12 inches • Cushions optional • 5 mounting styles.
WRITE FOR BULLETIN A-101

OTHER CYLINDERS
For fast action on mill type cylinders or specials designed to suit your exact needs, send outline of your requirements to our factory.

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TEER, WICKWIRE & CO.
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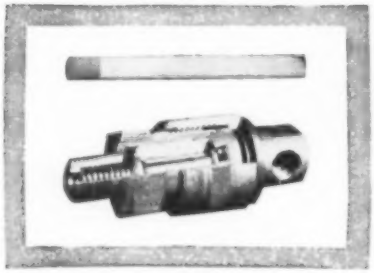
CIRCLE 123 ON TIME-SAVER CARD

CIRCLE 146 ON TIME-SAVER CARD

HUSCO
Hydraulic Controls are COST-SAVERS



Husco No. 4000 Rotary Swivel

This low cost, high efficiency Rotary Swivel is designed for both high pressure and high operating speeds in the brake and clutch field. Compact, for use in close quarters, it has spring-loaded Teflon rings, self-centering ball thrust bearing, highly efficient axial bearings. Size, only 3" x 1½".

Check HUSCO *first* for experienced custom engineering in Hydraulic Controls—Valves, Cylinders, Pumps—on your new designs. Write for details.

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HYDRAULIC UNIT SPECIALTIES CO.
Pumps • Valves • Cylinders
P. O. Box 257-A Waukesha, Wis.

POST SCRIPTS OF INDUSTRY

Automatic Switch Company announced the appointment of **E. Keller Company,** Williamsport, Pa., as authorized stocking distributors.

Hydraquip Corp., Houston, has opened a branch warehouse at 1517 Levee Street, Dallas, Texas, with **Joe Finley** in charge.

Lincoln Supply Co., Pawtucket, R. I., was named central distributor for **American Bosch** industrial accumulators in New England. The firm will cover the states of Maine, New Hampshire, Vermont, Rhode Island, Mass., and Conn.

G. M. Wallace & Co., representatives for **Commercial Filters Corporation,** have opened a new office in the Electric Building, El Paso, Texas. The office is under the direction of **B. M. Huffman.**

A larger plant for **Hoke, Inc.** has been completed in Cresskill, N. J. Built to provide production facilities for recent additions to the company's product lines, the new headquarters will enable Hoke to provide a greater measure of customer service. Approximately 48,000 of the plant's 64,000 square-foot area are devoted to manufacturing, and 3,200 square feet to engineering laboratories.

2568

REMOVE MOISTURE *from*

COMPRESSED AIR LINES

Air operated tools, instruments and controls demand air that is

COOL CLEAN & DRY

and the

MURPHY AFTERCOOLER SYSTEM
GUARANTEES IT!

Write now for FREE Data Sheet No. 2568.

JAMCO

JAS. A. MURPHY & CO., INC.
1417 EAST HIGH STREET, HAMILTON, OHIO

CIRCLE 92 ON TIME-SAVER CARD

any of 4 MOUNTINGS at 1 LOW BASE PRICE!

C10 SERIES • HEAVY DUTY

CUSHIONED AIR CYLINDERS . . .

- 150 psi, double acting; adjustable cushions, both ends!
- BORE sizes 1½"—6" with strokes up to 24" stocked for 24-hour delivery!
- QUICK delivery on other strokes.
- HEADS, sturdy cast semi-steel.
- RODS, hard chrome plated; all supplied with wrench flats.

24-HOUR DELIVERY!

Write, NOW, for Bulletin #258

SHEFFER PNEUMATICS HYDRAULICS
THE SHEFFER CORPORATION
Cincinnati 15, Ohio • Phone: VAlley 1-0320
Manufacturers of the industry's most complete line of air and hydraulic cylinders
SOLD BY LEADING DISTRIBUTORS NATIONWIDE

CIRCLE 117 ON TIME-SAVER CARD

Appointment of **Roger Zatkoff** as sales engineer at **J. N. Fauver Co., Inc.,** Detroit, has been announced. Zatkoff will specialize in the sale of hydraulic and pneumatic equipment in eastern Michigan.

Roger Zatkoff
J. N. Fauver Co., Inc.

Ivan L. Tournat
The Fornaciari Co.

The Fornaciari Company, Los Angeles, appointed **Ivan L. Tournat** to the sales engineering staff of its hydraulic division. Tournat's previous experience included the designing of hydraulic components and systems for the aircraft industry.

Womack Machine Supply Co., Dallas, has opened a Houston office located at 4111 Dennis Street, **Jack Donowho** and **Eddy Witt** as sales engineers. Both were previously with the Dallas office.

Richard Davis has become supervisor of Pydraul Sales for **Monsanto Chemical Company's Organic Chemical Division. Dale F. Smith** was named sales engineer in the functional

Richard Davis
Monsanto Chemical

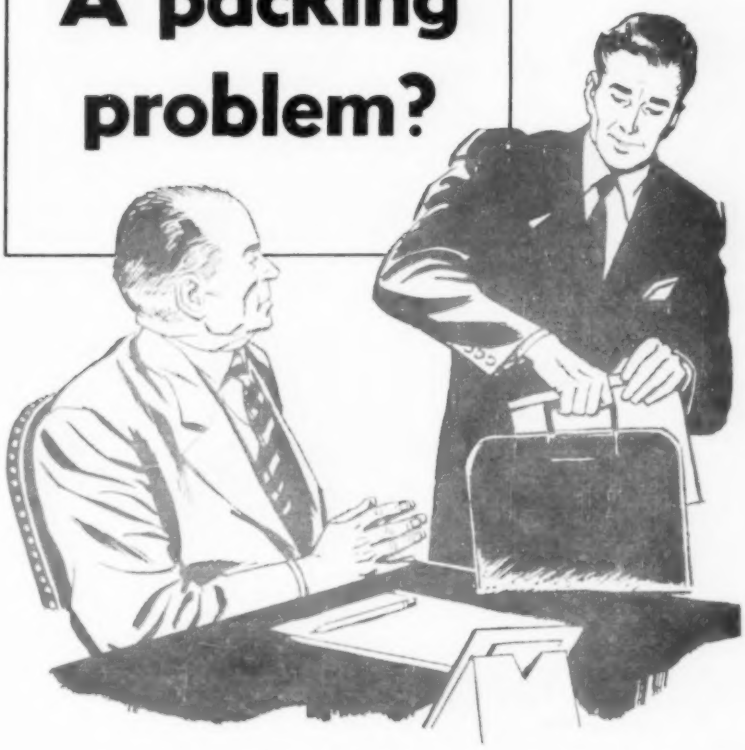
Dale F. Smith
Monsanto Chemical

fluids section. Davis joined Monsanto in 1951 and has served as a chemical engineer and in the plant development and production departments.

Appointment of **Whitson Engineering Co.,** Dallas Texas, as a master distributor for **U. S. Gauge Division of American Machine & Metals, Inc.** has been announced.

Continued on next page

A packing problem?



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If you find yourself with a packing problem, why not call in one of Page's packing experts and let him help you.

Whether the job calls for packings of Oak, Chrome or Retan, treated with any one of many impregnations, coatings or special finishes . . . or whether synthetics will work better . . . you know you can count on Page for quality and service.

Page offers you a complete line of U's, V's, Flanges, Cups, and O-rings, backed up by nearly a century of experience and complete facilities for production of one or thousands.

- for temperatures to 225° F.
- long life
- low cost
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- engineering assistance

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PAGE BELTING COMPANY
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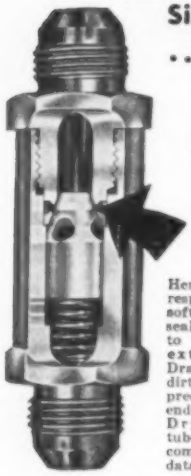
Page Packings — engineered to do a better job

CIRCLE 98 ON TIME-SAVER CARD

CIRCLE 79 ON TIME-SAVER CARD



Simple, Secure ... Leak-Tight! this FLEXIBLE SEAL SEAT*

Here's the secret . . . responsive action of the soft, long-lasting O-ring seal! Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts or extra end seals. Six standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Send for data sheet.

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Kep-O-seal

HYDRAULIC & PNEUMATIC
CHECK VALVES

* PATENT APPLIED FOR

POST SCRIPTS OF INDUSTRY

Gordon T. Grimstad was named sales manager of the **Bendix Filter Division, Bendix Aviation Corporation,** Madison Heights, Mich. He will direct sales of all Bendix Filter Division products.

G. T. Grimstad
Bendix Filter Div.

E. A. Malling
Flexonics Corp.

The new position of vice president of marketing at **Flexonics, Inc.,** has been filled by **Edward A. Malling.** The job was created as part of the new organization plan recently put into effect. In his position, Malling will be responsible for the complete marketing program.

Five new distributors for the **Sheffer Corporation** have been announced by Don Sheffer, vice president in charge of sales. Alabama and the northwestern section of Florida is represented by the **Gaugge Engineering Co., Inc.,** Birmingham, Alabama; **The Erv Schneider Co.,** Detroit, Mich., will serve in southeastern Michigan, with the exception of Wayne County; The Wayne County area is covered by **Ivan A. Schuel,** Detroit, Mich., **Baker Fluid Power,** Omaha Division, Omaha, Nebraska, is the distributor serving Nebraska and western Iowa; and the Springfield Division, Springfield, Missouri, of the same concern will cover southern Missouri.

James R. Parr has been appointed vice president and chief engineer of **American Industries Co.,** Bristol, Pa. His responsibili-

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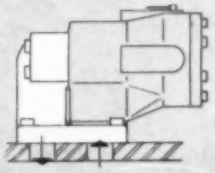
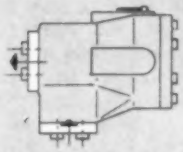


White area indicates sub-plate mount. This mounting eliminates leaks, permits interchange of units of any capacity.



Standard SAE flanges (shown above in white) or threaded bodies are optional.

New Tell-Tale® Filters for 5000 psi Service are Sub-Plate Mounted

Now you can specify Rosaen Tell-Tale filters for use in pressure lines too! And as well as the Tell-Tale when-to-clean indicator, you get sub-plate mounting. This puts the filter on the control panel with the valves, makes it easy to check and service. For full-flow, 5000 psi service, the Tell-Tale pressure filter unit is available in four capacities: 10, 20, 30, and 60 gpm. As with the suction and return line Tell-Tale filters, filter cartridges are easily accessible for cleaning by removing the end plate. Write today for complete information.

The ROSAEN COMPANY
1776 EAST NINE MILE ROAD • HAZEL PARK, MICHIGAN

Tell-Tale filters tell you when to clean, provide pressure-drop control

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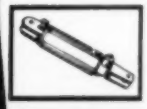
Free BIG CATALOG
NEW AND GOV'T. SURPLUS BARGAINS



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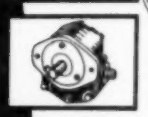

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CIRCLE 60 ON TIME-SAVER CARD

ties will include production, design and sales consultation. He was previously associated with the American Engineering Co.

Flodar Corp., Cleveland, Ohio, appointed **Marie K. Bauer** to the post of secretary-treasurer. Mrs. Bauer has been with the firm since 1945.

Marie K. Bauer
Flodar Corp.

R. R. Mease
Hydreco Div.

Richard R. Mease will cover western Ohio, with headquarters in Cleveland and **Charles B. Blackburn**, the eastern territory with offices in Philadelphia, for **Hydreco Division, The New York Air Brake Co. J. Barry Evans** has been transferred from Philadelphia to Kalamazoo, Mich., and named manager—parts and services.

Tuthill Pump Company, Chicago, Ill., promoted **Michael J. McCaughey** to general sales manager of the company. McCaughey joined Tuthill in 1954 as a sales engineer and becames midwestern regional sales manager in 1957. He will now direct all sales of the company.

M. J. McCaughey
Tuthill Pump Co.

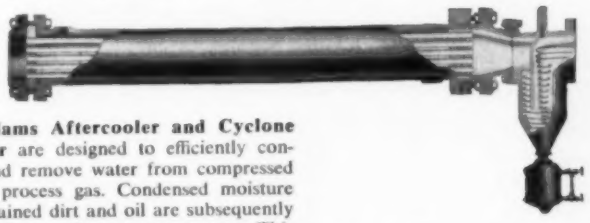
John H. Baer
Vickers Inc.

John H. Baer has been named to the newly created post of sales manager—administrative for the mobile hydraulics division of **Vickers Inc., Division of Sperry Rand Corp.** Baer was formerly sales manager of automotive products.

CIRCLE 2 ON TIME-SAVER CARD

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.
249 East Park Drive, Buffalo 17, New York

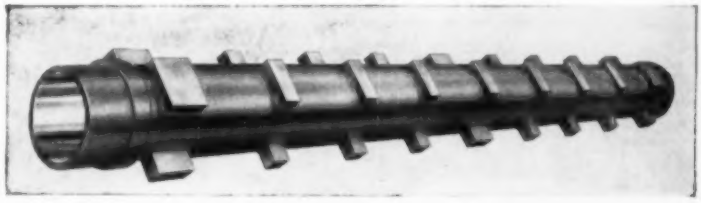


The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm where it is necessary to cool within 2°F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.



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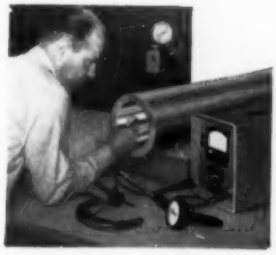

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If you want such a man to run your London office, or if you want to establish an office in Great Britain, drop me a letter. I'll tell you more about him.

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812 Huron Rd., Cleveland, Ohio

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30 new and 30 used Superior accumulators, 1 gallon, Snap ring type, 6½" diameter, 231 cu. inches —3000 psi. Write Box 911, Lynn, Mass.

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Long established Chicago manufacturer has opening for a man with pneumatic and hydraulic equipment experience. Territory is part of the Chicago area. College work helpful. At least 7 years business experience necessary. Direct industrial sales experience desirable.

A short practical training program will prepare you to sell a line of highly regarded pneumatic and hydraulic equipment. Good opportunity and attractive starting salary. Please write giving complete details. All correspondence will be confidential. Write Box 11358, APPLIED HYDRAULICS & PNEUMATICS.

SALES ENGINEER

National manufacturer needs qualified man to handle expanding line of filters for OEM, industrial and distributor accounts for aircraft, missile, government, automotive, and factory applications. Prefer experience in filters or allied lines. Engineering degree desired. Opportunities excellent for personal growth and compensation. Write Box 11258, APPLIED HYDRAULICS & PNEUMATICS.

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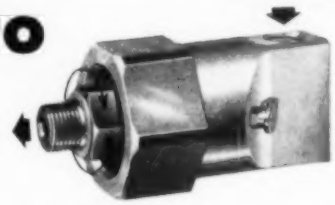
For High Speed Rotating Connections on
SPINDLES • CHUCKS • CLUTCHES

BARCO
NEW TYPE D REVOLVING JOINT



UP TO 10,000 RPM!

Use Barco's new TYPE D Revolving Joints wherever you need high speed, low torque, leakproof rotary connections for air, hydraulic, or coolant lines on clutches, machine tools and other equipment:

- **LIGHT RUNNING!** Ball bearing design for low torque and minimum wear.
- **LEAKPROOF!** Thanks to Barco's static O-ring seal.
- **PRECISION-BUILT!** All parts machined to close tolerances. Parts interchangeable and easily renewable.
- **COMPACT, DURABLE!** Easy to install where space is limited. Overall length, 3 1/16". Built for rugged service.
- **WIDE SPEED RANGE!** Up to 10,000 RPM. For pressures to 300 psi (air) or 3000 psi (hydraulic).

Send for Catalog Sheet 308.

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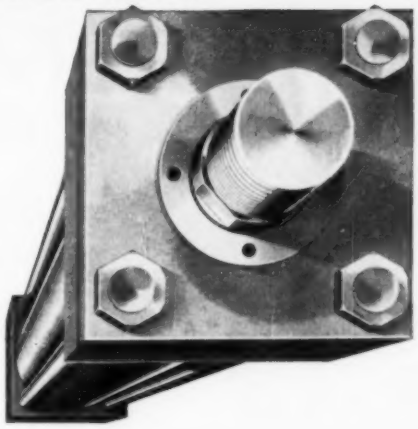
CIRCLE 11 ON TIME-SAVER CARD

NEW

Standard Line
Square-Head

HYDRAULIC CYLINDERS



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NUGENT

offers something *Unique* in strainers

Figure 1554A-4L strainer basket available in brass, steel or stainless steel screen. 8 x 8 to 100 x 100 mesh.

Figure 1554-4L and Figure 1490DD-4L strainer shells are identical. Strainer baskets shown are interchangeable in this model.

Figure 1490CN-4L basket. Star-shape provides 20% more free screen area in this size. Available same metals, mesh as Fig. 1554A.

Nugent pipe line strainers can materially reduce your maintenance labor costs and hold down-time to a minimum. Unlike most strainers of this type, both the Nugent round basket and star-shaped extended area strainers, shown above, catch and hold their accumulation of foreign solids in the interior of the strainer basket.

Dirty liquid, under pressure, enters the strainer through the bottom inlet. It is then propelled upward through the center tube assembly. Emerging at the top, the liquid travels outward and downward, through the mesh of the basket and to the side outlet. In this manner, foreign solids are trapped *inside* the strainer basket which is then easily lifted from the outer shell for cleaning. A clean spare basket may be immediately substituted and the dirty basket cleaned when convenient.

Most other strainers direct the flow of dirty liquid from the exterior to the interior of the basket. Thus, foreign matter is trapped between the outer shell and the basket; not inside. When these dirty baskets are removed for cleaning, it is almost impossible to prevent some foreign matter from flowing back to the inlet and outlet piping. This type also requires scraping and cleaning the interior of the outer shell, a time consuming task that increases down-time.

Nugent strainers can save you time and money. For full details write for Bulletin 6.

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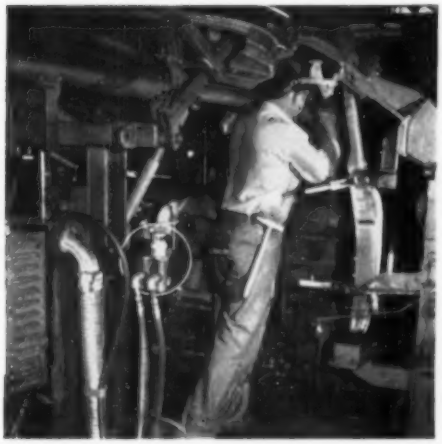

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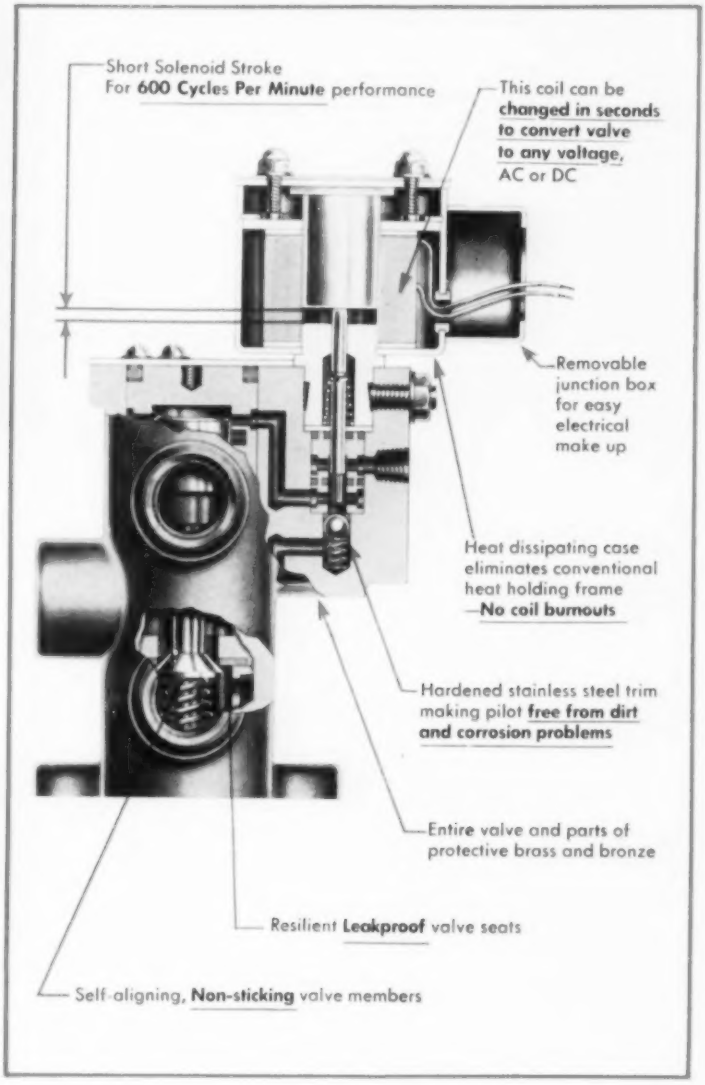
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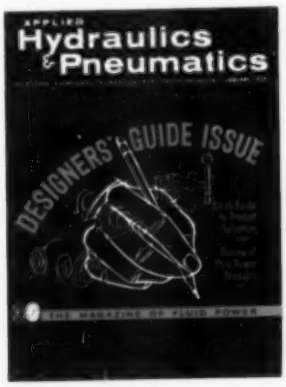

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